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MATERIALS ABOUT THE GENUS *AMPEDUS* DEJEAN, 1833 (COLEOPTERA: ELATERIDAE, AMPEDINI) IN THE FAUNA OF LATVIA

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Information about 19 species of the genus *Ampedus* Dej., which have been collected in Latvia, has been published in the article. 3 species *Ampedus vandalitiae* Lohse, *A. bouweri* Schimmel and *A. nemoralis* Bouwer are prescribed for the first time to the fauna of Latvia and Northern and Eastern Europe. 275 specimens of this genus, which are stored in the collection of Daugavpils University Institute of Systematic Biology (DUBC), have been processed.

Key words: Ampedus, Elateridae, fauna, Latvia

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Introduction

The genus *Ampedus* Dejean, 1833 (Coleoptera: Elateridae, Ampedini) is investigated rather incompletely in Latvia. Hitherto no special researches have been dedicated to its fauna in Latvia.

All 275 specimens of this genus, who belong to 17 species were determined while taking stock in the beetles collection at Daugavpils University Institute of Systematic Biology (DUBC). *Ampedus vandalitiae* Lohse, *A. bouweri* Schimmel and *A. nemoralis* Bouwer were realized among them, these species are new for the fauna of Latvia and Northern and Eastern Europe. Alltogether 19 species of the genus *Ampedus* Dej. have been presented in the fauna of Latvia.

In the list of species after the name of the species there have been published: the list of the bibliographical sources, the distribution in 5 regions of Latvia: KU – Kurzeme, ZE – Zemgale, SE – Augszeme (Selija) (see picture 1) and the code of the chorotype: OLA – Holarctic, PAL – Palearctic, SIE – Sibero-European, EUR – European, NEU – North European, CEU – Central European, EME – Europeo-Mediterranean. Classification of Chorotypes is made according to A. Vigna Taglianti et al. (1999) on the basis of H. Silfverberg´s (1999) publication about zoo-geographical analysis of click beetles in Northern Europe. The digital code in the data base of DUBC is published for each species. The systematics of the genus in this article conforms to the one being used in monograph of S.Laibner (2000).

Results and Discussion

Genus *Ampedus* Dej. is cosmopolitan, comprises taxa of uniform appearance whose differentiation is very difficult (Laibner 2000). More that 330

species are known in the world, majority of them can be distributed in Holarctic. More than 190 species are known in Palearctic, in Europe – 63 species (Laibner 2000), in Northern Europe – 21 species (Silfverberg 2004), but in Latvia – 19 species.

The first information about the species of the genus *Ampedus* Dej. in the fauna of Latvia were published in the beginning of the 19th century, when J.Groschke˙s (1805) overview of the Kurzeme fauna was published. In later years 40 works were published, in which the information about the species of this genus in the fauna of Latvia was given.

Out of two most widespread sub-genera of this genus in Europe (Laibner 2000), all the species of the fauna of Latvia belong to *Ampedus* s.str.

17 species of this genus were determined in the materials of the beetles˙ collection at Daugavpils University Institute of Systematic Biology (DUBC). In the result of the researches the number of species, which can be fonded in Latvia, has increased from 16 species (Spuris 1981, Barševskis 2001) to 19 species, because three new species *Ampedus vandalitiae* Lohse, *A. bouweri* Schimmel and *A. nemoralis* Bouwer were determined, they are new for the fauna of Latvia and Northern and Eastern Europe.

Two species (*A. vandalitiae* Lohse, *A. nemoralis* Bouwer) are known for the time being only from one place in Latvia, four species (*A. bouweri* Schimmel, *A. hjorti* (Rye), *A. suecicus* Palm, *A. cardinalis* (Schioedte)) are very infrequent (2 – 5 places are known), five species (*A. cinnabarinus* Eschscholtz, *A. elongatulus* (Fabricius), *A. elegantulus* (Schoenherr), *A. praeustus* (Fabricius), *A. tristis* (Linnaeus)) are infrequent in Latvia (6 – 10 places are known), three species (*A. nigroflavus* (Goeze), *A. erythrogonus* (Mueller), *A. nigrinus* (Herbst)) are rather infrequent in Latvia (11 – 15 places are known) and remaining five species (*A. sanguineus* (Linnaeus), *A. pomonae* (Stephens), *A. sanguinolentus* (Schrank), *A. pomorum pomorum* (Herbst), *A. balteatus* (Linnaeus)) are frequent in Latvia (more than 10 places are known).

While analyzing the dissemination of the species of the genus *Ampedus* Dej. in the fauna of Latvia it can be concluded that the range of the chorotypes is rather wide: Palearctic – 6 species (*A. cinnabarinus* Eschscholtz, *A. sanguineus* (Linnaeus), *A. pomonae* (Stephens), *A. sanguinolentus* (Schrank), *A. pomorum pomorum* (Herbst), *A. balteatus* (Linnaeus)), European – 4 species (*A. vandalitiae* Lohse, *A. nemoralis* Bouwer, *A. bouweri* Schimmel, *A. cardinalis* (Schioedte)) Sibero - European –3 species (*A. elongatulus* (Fabricius), *A. praeustus* (Fabricius), *A. tristis* (Linnaeus)), Europeo - Meriditerranean – 3 species (*A. nigroflavus* (Goeze), *A. elegantulus* (Schoenherr), *A. erythrogonus* (Mueller)), Holarctic – 1 species (*A. nigrinus* (Herbst)), North European – 1 species (*A. suecicus* Palm), Central European – 1 species (*A. hjorti* (Rye)).

At present none of the species of this genus has been included in list of the protected species in Latvia, but one species *A. erythrogonus* (Mueller) is included in the list of indicator species of natural forest habitats.

The research of the fauna of this genus in Latvia must be continued, because there is a chance to find several more new species for the fauna of Latvia.

List of species

***Ampedus* Dejean, 1833**

(= Elater auct. nec Linnaeus, 1758)
***Ampedus* s. str.**

***Ampedus* (s. str.) *cinnabarinus* (Eschscholtz, 1829)**

Eschscholtz 1830, Kawall 1858, Seidlitz 1872, 1888, Stiprais 1976, Barševskis 1988, 1993c, 2001, Spuris 1981, Silfverberg 1979, 1992, 2004, Lundberg 1995,

Telnov et al 1997, Barševskis et al 2002, Telnov 2004

Chorotype: PAL

DUBC: 4 specimens. Daugavpils Distr., Silene Nature Park, Ilgas, 23.06.1986. (1, A,Barševskis leg.), 06.03.1991. (1, A.Barševskis leg.), 06.1991. (1, A.Barševskis leg.); Daugavpils Distr., Višķi, 03.05.1987. (1, A.Barševskis leg.).

DUBC Digital Code: 1/067/043/004

DUBC Letter Code: AMPE CINN

***Ampedus* (s. str.) *sanguineus* (Linnaeus, 1758)**

Groschke 1805, Precht 1818, Gimmerthal 1829, Eschscholtz 1830, Kawall 1858, Seidlitz, 1872, 1888, Brammanis 1930, Spuris 1974a, 1981, Stiprais 1976, Silfverberg 1979, 1992, 2004, Barševskis 1988, 1993c, 1998c, Lundberg 1995, Telnov et al 1997, Barševskis et al 2002, Telnov 2004, Valainis 2004.

Chorotype: PAL

DUBC: 26 specimens. Daugavpils Distr., Silene Nature Park, Ilgas, 1986. (1, A.Barševskis leg.), 04.07.1989. (1, A.Barševskis leg.), 04.06.1991 (2, A.Barševskis leg.), 02.06.1992. (1, A.Barševskis leg.), 10.06.1992. (1, A.Barševskis leg.), 18.06.1995. (1, A.Barševskis leg.), 29.-30.04.2000. (1, A.Barševskis leg.); Daugavpils Distr., Višķi, 30.03.1986. (1, A.Barševskis leg.), 31.03.1987. (2, A.Barševskis leg.); Daugavpils Distr., Oborūni, 19.05.2001. (1, G. Lociks leg.); Jelgava Distr., Jelgava 28.05.2002. (7, M.Bičevskis leg.); Krāslava Distr., Krāslava, 1991. (1, A.Barševskis leg.); Madona Distr., Kalsnava, 08.2001., (3, A.Bikše leg.), 06.06.2002. (2, M.Bičevskis leg.); Ventspils Distr. Moricsala, Moricsala Nature Reserve, 05.2003. (1, U.Valainis leg.).

DUBC Digital Code: 1/067/043/006

DUBC Letter Code: AMPE SANG

***Ampedus* (s. str.) *pomonae* (Stephens, 1830)**

Seidlitz 1872, 1888, Trauberga 1957, Spuris 1974a, 1975, 1981, Stiprais 1976, Silfverberg 1979, 1992, 2004, Barševskis 1988, 1993c, Melecis 1995, Lundberg 1995, Telnov et al 1997, Leiskina 2000, Barševskis et al 2002, Telnov 2004.

Chorotype: PAL

DUBC: 31 specimens. Aizkraukle Distr., Aizkraukle bog, 04.05.1995. (4, A.Barševskis leg.), 21.06.1995. (3, A.Barševskis leg.); Balvi Distr., Kuprava, 19.05.1991, (2, A.Barševskis leg.); Daugavpils Distr., Demene, 17.05.1994. (1, A.Barševskis leg.); Daugavpils Distr., Silene Nature Park, Ilgas, 24.04.1993. (1, A.Barševskis leg.); 14.05.1993. (1, A.Barševskis leg.), 06.1994. (2, A.Barševskis leg.), 04.07.1994. (1, A.Barševskis leg.), 13.06.1995. (1, A.Barševskis leg.), 13.09.1995. (1, A.Barševskis leg.), 25.-30.05.1998., (1, A.Barševskis leg.), 06.06.2000. (1, A.Barševskis leg.); Daugavpils, near Daugava river, 14.04.1991. (1, A.Barševskis leg.); Jēkabpils Distr., Dunava, 05.03.1995. (1, A.Barševskis leg.), 22.-23.06.1998., (1, A.Barševskis leg.); Krāslava Distr., Šķeltova (Šķeltiņi), 14.06.1987. (1, A.Barševskis leg.), 30.09.1994. (2, A.Barševskis leg.); Limbaži Distr., Bīriņi, 15.-16.03.2001. (1, A.Barševskis leg.); Madona Distr., Kalsnava, 06.06.2002. (1, M.Bičevskis leg.), 06.2002. (2, A.Bikše leg); Preiļi Distr., Līvāni, 24.06. 1985. (2, A.Barševskis leg.); Preiļi Distr., Jersika, „Kurpnieki", 04.05.2005. (1, A.Barševskis leg.), Preiļi Distr., Pelēči, 01.07.1997. (1, I.Jurkjāne leg.).

DUBC Digital Code: 1/067/043/007

DUBC Letter Code: AMPE POMO

***Ampedus* (s. str.) *sanguinolentus* (Schrank, 1776)**

Precht 1818, Gimmerthal 1829, Eschscholtz 1830, Kawall 1858, Seidlitz 1872, 1888, Lindberg 1932,

Trauberga 1957, Spuris 1974a, 1981, Stiprais 1976, Silfverberg 1979, 1992, 2004, Barševskis 1988, 1993c, 1998b, 1998c, Lundberg 1995, Telnov et al 1997, Barševskis et al 2002, Jansson 2002, Telnov 2004, Valainis 2004.

Chorotype: PAL

DUBC: 26 specimens. Aizkraukle Distr, Aizkraukle bog, 04.05.1995. (1, A.Barševskis leg.); Daugavpils Distr., Silene Nature Park, Ilgas, 14.05.1993. (2, A.Barševskis leg.), 10.07.1993. (1, A.Barševskis leg.), 06.1994., (2, A.Barševskis leg.), 03. 07.1994. (1, A.Barševskis leg.), 15.06.1995. (1, A.Barševskis leg.), 09.05.1996. (2, A.Barševskis leg.), 25.-30.05.1996. (1, A.Barševskis leg.), 05.06.1997. (1, A.Barševskis leg.), 15.06.1997. (1, A.Barševskis leg.), 10.07.2000. (1, A.Rutka), 06.06.2002. (1, A.Barševskis leg.); Daugavpils Distr., Mežciems, 20.05.2002. (1, A.Barševskis leg.); Daugavpils Distr., Višķi, 07.04.1985. (1, A.Barševskis leg.), 23.04.1986. (1, A.Barševskis leg.); Daugavpils Distr. Arteņi, 06.05.1986. (1, A.Barševskis leg.); Jēkabpils Distr., Dunava, 25.04.1998. (1, A.Barševskis leg.), 22.-23.06.1998. (1, A.Barševskis leg.); Krāslava Distr., Šķeltova (Šķeltiņi), 08.04.1987. (1, A.Barševskis leg.), 02.05.1993. (1, A.Barševskis leg.); Preiļi Distr., Jersika, „Kurpnieki", 04.05.2005. (1, A.Barševskis leg.), 22.05.2005. (2, A.Barševskis leg.).

DUBC Digital Code: 1/067/043/008

DUBC Letter Code: AMPE SNGL

Ampedus (s. str.) *vandalitiae* Lohse, 1976

DUBC: 1 specimen - LATVIA: Daugavpils Distr. , Silene Nature Park, Ilgas 06.06.2002. (in edge of a mixed forest on a old oak; A.Barševskis leg.).

Chorotype: EUR. Known from Poland, Germany, Czech Republic, Slovak Republic and Hungary (Laibner 2000).

Note: A new species for fauna of Latvia, Baltic Region, North and East Europe. Very rare and insufficiently known species.

DUBC Digital Code: 1/067/043/012

DUBC Letter Code: AMPE VAND

Ampedus (s. str.) *bouweri* Schimmel, 1984

DUBC: 2 specimens - LATVIA: Krāslava Distr. , Izvalta, 28.10.1986. (1, in a mixed forest; A.Barševskis leg.); LATVIA: Madona Distr., Kalsnava, 06.2002. (1, in a pine forest, A.Bikše leg.).

Chorotype: EUR. Known from Germany and Czech Republic (Laibner 2000).

Note: A new species for fauna of Latvia, Baltic Region, North and East Europe. Very rare and insufficiently known species.

DUBC Digital Code: 1/067/043/013

DUBC Letter Code: AMPE BOUW

Ampedus (s. str.) *nigroflavus* (Goeze, 1777)

(?= Elater erubescens Eschscholtz 1830: 17)

Eschscholtz 1830 (? *erubescens)*, Kawall 1858, Seidlitz 1872, 1888, Lackschewitz 1927, Lackschewitz, Mikutowicz 1939, Spuris 1974a, 1981 (Gymmerthal coll.), Stiprais 1976, Silfverberg 1979, 1992, 2004, Barševskis 1993c, Lundberg 1995, Telnov et al 1997, Jansson 2002, Barševskis et al 2002, Telnov 2004, Barševskis et al 2004, Valainis 2004.

Chorotype: EME

DUBC: 12 specimens. Aizkraukle Distr., Aizkraukle bog, 04.05.1995. (1, A.Barševskis leg.); Madona Distr., Kalsnava, 06.2002. (2, A.Bikše leg.); Preiļi

Distr., Priekuļi, 23.06.1991. (1, D.Skutele leg.), Preiļi Distr., Jersika, „Kurpnieki", 07.05.2005. (1, A.Barševskis leg.); Ventspils Distr., Moricsala, Moricsala Nature Reserve, 05.2002. (1, U.Valainis leg.), 06.2003. (3, U.Valainis leg.), 14.05.2004. (1, A.Barševskis, U.Valainis leg.), 25.06.2004. (1, A.Barševskis, U.Valainis leg.), 09.07.2004. (1, A.Barševskis, U.Valainis leg.).

DUBC Digital Code: 1/067/043/014

DUBC Letter Code: AMPE NGFL

***Ampedus* (s. str.) *pomorum pomorum* (Herbst, 1784)**

(= Elater ochropterus Eschscholtz 1830: 17)

Eschscholtz 1830 (*ochropterus*), Kawall 1858, Seidlitz 1872, 1888, Spuris 1974a, 1981, Stiprais 1976, Silfverberg 1979, 1992, 2004, Barševskis 1988, 1993c, Melecis 1995, Lundberg 1995, Telnov et al 1997, Barševskis et al 2002, Telnov 2004.

Chorotype: PAL

DUBC: 44 specimens. Daugavpils Distr., Silene Nature Park, Ilgas, 13.06.19967. (1, A.Barševskis leg.), 06.06.2000. (1, A.Barševskis leg.), 06.06.2002. (1, A.Barševskis leg.); Daugavpils Distr., Naujene, 11.03.1992. (1, A.Barševskis leg.); Daugavpils Distr., Svente, 10.07.2003. (1, N.Strode leg.); Daugavpils Distr., Mežciems, 01.07.1995. (1, A.Barševskis leg.); 07.07.1995. (1, A.Barševskis leg.), 20.05.2002. (1, A.Barševskis leg.); Daugavpils Distr., Nīcgale, 26.06.1996. (1, R.Cibuļskis leg.); Daugavpils Distr., Pilskalne, Nature Park „Pilskalnes Siguldiņa", 05.05.1992. (1, J.Soms leg.); Jēkabpils Distr., Tadenava, 14.05.2005. (2, A.Barševskis leg.);Jēkabpils Distr., Dunava, 12.07.1997. (1, A.Barševskis leg.); Jēkabpils Distr, Zasa, 17.11. 1997. (1, I.Leiskina leg.); Jelgava Distr., Jelgava, 28.05.2002. (3, M.Bičevskis leg.); Jūrmla, Kauguri, 1994., (1, in dunes, A.Barševskis leg.); Krāslava Distr., Šķeltova (Šķeltiņi), 01.11.1986. (1, A.Barševskis leg.); Krāslava Distr., Izvalta, „Stivriņi", (1, A.Barševskis leg.); Krāslava Distr., Varnaviči, 25.05.1990. (1, A.Barševskis leg.); Limbažu Distr., Bīriņi, 15.-16.03.2001. (3, A.Barševskis leg.); Limbaži Distr., Svētciems, 12.10.1990. (3, J.Soms leg.); Madona Distr., Krustkalni Nature Reserve, 23, 05.1991. (1, A.Barševskis leg.); Madona Distr., Kalsnava, 06.06.2002. (2, M.Bičevskis leg.), 06.2002. (2, A.Bikše leg.); Preiļi Distr., Preiļi, 01.05.1998. (1, R.Gribusts leg.); Ventspils Distr., Moricsala, Moricsala Nature reserve, 05.2002. (1, U.Valainis leg.), 05.2003. (1, U.Valainis leg.), 06.2003. (6, U.Valainis leg.), 07.2003. (1, U.Valainis leg.), 25.06.2004. (3, A.Barševskis, U.Valainis leg.).

DUBC Digital Code: 1/067/043/016

DUBC Letter Code: AMPE POMR

***Ampedus* (s. str.) *nemoralis* Bouwer, 1980**

DUBC: 19 specimens – LATVIA: Ventspils Distr., Moricsala, Moricsala Nature Reserve, 29.06.2002. (1, U.Valainis leg.), 05.2003. (17, in windows traps on oaks, U.Valainis leg.), 25.06.2004. (1, A.Barševskis, U.Valainis leg.).

Chorotype: EUR Distributed in North, Central and South Europe (Laibner 2000).

Note: A new species for fauna of Latvia and Baltic Region. Very rare and insufficiently known species.

DUBC Digital Code: 1/067/043/020

DUBC Letter Code: AMPE NEMO

***Ampedus* (s. str.) *hjorti* (Rye, 1905)**

Lindberg 1932, Spuris 1974a, 1981, Silfverberg 1979, 1992, 2004, Barševskis 1993c, Lundberg 1995, Telnov et al 1997, Laibner 2000, Barševskis et al 2002, Jansson 2002, Telnov 2004, Valainis 2004, Barševskis, Valainis, Cibuļskis 2005.

Chorotype: CEU

DUBC: 3 specimens. Ventspils Distr., Moricsala, Moricsala Nature Reserve, 06.2003. (2, U.Valainis leg.), 14.05.2004. (1, A.Barševskis leg.).

Note: In Latvia is very rare and insufficiently known species. Should be more widely distributed.

DUBC Digital Code: 1/067/043/017

DUBC Letter Code: AMPE HJOR

***Ampedus* (s. str.) *elongatulus* (Fabricius, 1787)**

(?=Elater erubescens Eschscholtz 1830: 17)

Fleischer 1829, Eschscholtz 1830 (? *erubescens)*, Kawall 1858, Seidlitz 1872, 1888, Spuris 1981, Silfverberg 1979, 1992, 2004, Barševskis 1993c, Lundberg 1995, Telnov et al 1997, Barševskis et al 2002, Telnov 2004.

Chorotype: SIE

DUBC Digital Code: 1/067/043/021

DUBC Letter Code: AMPE ELON

***Ampedus* (s. str.) *elegantulus* (Schönherr, 1817)**

Seidlitz 1872, 1888, Spuris 1974a, 1981, Silfverberg 1979, 1992, 2004, Barševskis 1993c, Lundberg 1995, Telnov et al 1997, Barševskis 2001, Barševskis et al 2002, Telnov 2004.

Chorotype: EME

DUBC: 3 specimens. Daugavpils Distr., Silene Nature Park, Ilgas, 06.1991. (2, A.Barševskis leg.), 12.07.1993. (1, A.Barševskis leg.).

Note: In Latvia very rare species.

DUBC Digital Code: 1/067/043/022

DUBC Letter Code: AMPE ELEG

***Ampedus* (s. str.) *suecicus* Palm, 1976**

(=. borealis (Palm, 1947 nec Paykull, 1800))

Barševskis 2001, Jansson 2002, Barševskis et al 2002, Telnov 2004, Silfverberg 2004, Valainis 2004.

Chorotype: NEU

DUBC: 1 specimen. Daugavpils Distr., Silene Nature Park, Ilgas, 13.06.1997. (1, A.Barševskis leg.).

Note: This species in Latvia is known only from Ilgas (Silene Nature Park) in SE Latvia. Very rare and insufficiently known species. Schould be more widely distributed.

DUBC Digital Code: 1/067/043/023

DUBC Letter Code: AMPE SUEC

***Ampedus* (s. str.) *balteatus* (Linnaeus, 1758)**

Precht 1818, Gimmerthal 1829, Eschscholtz 1830, Kawall 1858, Seidlitz 1872, 1888, Trauberga 1957, Spuris 1974a, 1975, 1981, Stiprais 1976, Silfverberg 1979, 1992, 2004, Barševskis 1988, 1993c, Melecis 1995, Lundberg 1995, Telnov et al 1997, Barševskis et al 2002, Jansson 2002, Telnov 2004, Valainis 2004.

Chorotype: PAL

DUBC: 62 specimens. Aizkraukle Distr., Aizkraukle bog, 04.05.1995. (2, A.Barševskis leg.); Balvi Distr., Kuprava, 19.05.1991. (1, A.Barševskis leg.); Daugavpils Distr., Silene Nature Park, Ilgas, 05.06.1991. (1, A.Barševskis leg.), 06.06.1991 (1, A.Barševskis leg.), 16.06.1991. (1, A.Barševskis leg.), 23.05.1992. (1, A.Barševskis leg.), 24.05.1992. (2, A.Barševskis leg.), 30.05.1992. (1, A.Barševskis leg.), 02.06.1992. (1, A.Barševskis leg.), 09.06.1992. (1, A.Barševskis leg.), 14.06.1995. (1, A.Barševskis leg.), 05.06.1997. (1, A.Barševskis leg.), 25.-30.06.1998. (1, A.Barševskis leg.); Daugavpils Distr., Oborūni

19.05.2001. (2, G.Lociks leg.); Daugavpils Distr., Križi, 20.05.2001. (1, G.Lociks leg.); Daugavpils Distr., Mežciems, 18.04.1993. (1, A.Barševskis leg.), 20.05.2002. (2, A.Barševskis leg.), 16.06.2005. (1, A.Bukejs leg.); Daugavpils Distr., Višķi, 16.06.1987. (1, A.Barševskis leg.); Daugavpils Distr., Kalupe, 26.11.1986. (1, A.Barševskis leg.); Gulbene Distr., Lejasciems, 05.-06.2003. (9, I.Kampāne, A.Barševskis leg.), 07.2003. (4, I.Kampāne, A.Barševskis leg.), 08.2003. (2, I.Kampāne, A.Barševskis leg.), 10.07.2005. (2, A.Barševskis, J.Laizāns leg.); Gulbene Distr., Gulbītis, near Lake Ušūrs, 05.-06.2003. (2, O.Koškina, A.Barševskis leg.), 08.2003. (2, O.Koškina, A.Barševskis leg.); Jēkabpils Distr., Dunava, 23.04.2000. (1, A.Barševskis leg.); Krāslava Distr., Priedaine, 03.07.1991. (1, A.Barševskis leg.); Krāslava Distr., izvalta, 09.06.1987. (1, A.Barševskis leg.); Krāslava Distr., Šķeltova (Šķeltiņi), 07.03.1986. (2, A.Barševskis leg.); Kuldīga Distr., Rudbārži, 28.04.1998. (1, N.Savenkovs leg.); Madona Distr., Krustkalni Nature Reserve, 23.05.1991. (1, A.Barševskis leg.); Madona Distr., Kalsnava 06.2002. (2, A.Bikše leg.), 06.06.2002. (4, M.Bičevskis leg.); Rēzekne Distr., Nagļi, 01.05.1998. (2, near lake Lubāns, A.Bojāre leg.); Cēme 08.06.1991. (1, A.Titovs leg.); Ventspils Distr., Moricsala, Moricsala Nature reserve, 05.2003. (1, U.Valainis leg.).

DUBC Digital Code: 1/067/043/024

DUBC Letter Code: AMPE BALT

***Ampedus* (s. str.) *praeustus* (Fabricius, 1792)**
(= *var. exsanguis* Eschscholtz, 1830: 17)

Precht 1818, Gimmerthal 1829, Eschscholtz 1830 (*var. exsanguis*), Kawall 1858, Seidlitz 1872, 1888, Lackschewitz, 1927, Spuris 1974a, 1981, Stiprais 1976, Silfverberg 1979, 1992, 2004, Barševskis 1993c, Lundberg 1995, Telnov et al 1997, Barševskis et al 2002, Jansson 2002, Telnov 2004, Barševskis et al 2004, Valainis 2004.

Chorotype: SIE

DUBC: 3 specimens. Daugavpils Distr., Višķi, near Dotkas Lake, 13.05.1995. (1, A.Barševskis leg.); Ventspils Distr., Moricsala, Moricsala Nature reserve, 09.07.2004. (1, A.Barševskis, U.Valainis leg.), 06.08.2005. (1, A.Barševskis leg.).

DUBC Digital Code: 1/067/043/027

DUBC Letter Code: AMPE PRAE

***Ampedus* (s. str.) *cardinalis* (Schiödte, 1865)**

Seidlitz 1872, 1888, Gurjeva 1979, Silfverberg 1979, 1992, 2004, Melecis 1995, Lundberg 1995, Telnov et al 1997, Telnov 2004,.

Chorotype: EUR

Note: In Latvia is very rare and insufficiently known species.

DUBC Digital Code: 1/067/043/028

DUBC Letter Code: AMPE CARD

-. *Ampedus* (s. str.) *aethiops* (Lacordaire, 1835))

Kawall 1858, Spuris 1981 (deleted from check – list), Telnov et al 1997 (deleted from check – list), Telnov 2004 (deleted from check – list)

DUBC Digital Code: 1/067/043/031

DUBC Letter Code: AMPE BRUN

***Ampedus* (s. str.) *tristis* (Linnaeus, 1758)**

Precht 1818, Kawall 1858, Seidlitz 1872, 1888, Mikutowicz 1905, Spuris 1974a, 1981 (Gymmerthal coll.), Silfverberg 1979, 1992, 2004, Lundberg 1995, Cinītis 1997, Telnov et al 1997, Barševskis 1993a, 1993c, 1997, 2001, Bojāre 2000, Barševskis et al 2002, Telnov 2004, Barševskis et al 2004

Chorotype: SIE

DUBC: 6 specimens. Daugavpils Distr., Silene Nature Park, Ilgas, 30.06.1996. (1, A.Barševskis

leg.); Daugavpils Distr., Nīcgale, 15.05.1998., (1, R.Cibuļskis leg.); Gulbene Distr., Lejasciems, 07.2003. (1, I.Kampāne, A.Barševskis leg.); Madona Distr., Kalsnava, 06.06.2002. (2, M.Bičevskis leg.); Rēzekne Distr., Nagļi, near Lake Lubāns, 01.05.1998. (1, A.Bojāre leg.).

DUBC Digital Code: 1/067/043/032

DUBC Letter Code: AMPE TRIS

***Ampedus* (s. str.) *erythrogonus* (Müller, 1821)**

Fleischer 1829, Kawall 1858, Seidlitz 1872, 1888, Mikutowicz 1911, Lackschewitz 1927, Lackschewitz, Mikutowicz 1939, Spuris 1974a, 1981 (Gymmerthal coll.), Stiprais 1976, Silfverberg 1979, 1992, 2004, Barševskis 1993a, 1993c, Melecis 1995, Lundberg 1995, Cibuļskis 1997, Telnov et al 1997, Barševskis et al 2002, Jansson 2002, Telnov 2004, Barševskis et al 2004, Valainis 2004.

Chorotype: EME

DUBC: 15 specimens. Kuldīga Distr., Rudbārži, 09.09.2004. (1, A.Barševskis leg.); Kuldīga Distr., Vāme, 10.09.2004. (1, A.Barševskis leg.); Madona Distr., Kalsnava, 06.06.2002. (1, M.Bičevskis leg.); Ventspils Distr., Moricsala, Moricsala Nature reserve, 06.2002. (1, U.Valainis leg.), 04.2003. (1, U.Valainis leg.), 05.2003. (1, U.Valainis leg.), 06.2003. (8, U.Valainis leg.), 07.2003. (1, U.Valainis leg.).

Note: Included on the list of indicator species of natural forest habitats.

DUBC Digital Code: 1/067/043/035

DUBC Letter Code: AMPE ERYT

***Ampedus* (s. str.) *nigrinus* (Herbst, 1784)**

Fleischer 1829, Kawall 1858, Seidlitz 1872, 1888, Trauberga 1957, Stiprais 1976, Spuris 1981, Silfverberg 1979, 1992, 2004, Barševskis 1993c, 2001, Melecis 1995, Lundberg 1995, Telnov et al 1997, Barševskis 2001, Barševskis et al 2002, Telnov 2004, Barševskis et al 2004.

Chorotype: OLA

DUBC: 17 specimens. Daugavpils Distr., Silene Nature Park, Ilgas, 06.06.1991. (1, A.Barševskis leg.), 25.-30.05.1998. (1, A.Barševskis leg.), 14.09.2002. (1, A.Barševskis leg.); Balvi Distr., Kuprava, 19.05.1991. (2, A.Barševskis leg.); Gulbene Distr., Gulbītis, near Ušūrs lake, 05.-06.2003. (6, O.Koškina, A.Barševskis leg.), 07.2003. (1, O.Koškina, A.Barševskis leg.); Gulbene Distr., Lejasciems, 07.2003. (2, I.Kampāne, A.Barševskis leg.); Madona Distr., Kalsnava, 06.2002. (2, A.Bikše leg.); Egļupe, 29.06.1992. (1, A.Titov leg.).

DUBC Digital Code: 1/067/043/037

DUBC Letter Code: AMPE NIGR

-. *Ampedus* (s. str.) *mixtus* (Herbst, 1806)

Gimmerthal 1829, Spuris 1981 (deleted from check – list), Telnov et al 1997 (deleted from check – list), Telnov 2004 (deleted from check – list).

DUBC Digital Code:

DUBC Letter Code: AMPE MIXT

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ANALYSIS OF STRUCTURES OF CARABID (*COLEOPTERA, CARABIDAE*) COMMUNITIES FROM MEADOWS, CROPS AND WASTELAND ON CHERNOZEM SOIL AROUND THE VILLAGE OF TELATYN IN ROZTOCZE

Stanisław Huruk

Huruk S. 2005. Analysis of structures of carabid (*Coeoptera., Carabidae*) communities from meadows, crops and wasteland on chernozem soil around the village of Telatyn in Roztocze. *Acta Biol. Univ. Daugavp., 5 (1): 11 - 22.*

Carabid beetles were collected in 1996 in the village of Telatyn in Roztocze near the Polish-Ukrainian border, using glycol-filled Barber pitfall traps. The aim of the study was to characterise and compare carabid community structures in cultivated chernozem soils (moist hay meadows representing a meadow community with *Deschampsia caespitosa*, crops of sugar beet and hop and a strip of xerothermal wasteland). Four permanent study sites with 6 traps were set up in each habitat. Samples were obtained on a continuous basis from May to September. The sampling period was divided into 5 monthly cycles. The total yield was 8581 *Carabidae* individuals representing 58 species, with 4070 individuals and 36 species in the meadow, 2380 individuals and 38 species in the sugar beet crop, 1831 individuals and 31 species in the hop crop, and 228 individuals and 31 species in the wasteland. Trapability statistics were as follows: meadow – 1.13; sugar beet – 0.66; hop – 0.51; wasteland – 0.06. Qualitative similarity between communities ranged from 42% to 55%, and qualitative-quantitative similarity ranged from 3% to 33%. The following species were eudominants in the individual communities: *P. melanarius* and *P. cupreus* in the meadows, *H. rufipes* and *P. lepidus* in the sugar beet crop, *H. rufipes* in the hop crop, and *Carabus cancellatus* and *H. rufipes* in the wasteland. Similarity of structures of dominance ranged from 8.71% to 31.22%. The highest diversity was in the carabid community inhabiting the wasteland ($H' = 3.8$), and the lowest, in the meadow community ($H' = 1.9$). The dominant ecological elements were as follows: in terms of habitat, open-area species; in terms of feeding habits, large zoophages in the meadows, small zoophages in the sugar beet and hemizoophages in the hop and wasteland; in terms of breeding type, autumn breeders in all habitats. The dominant zoogeographical elements were Euro-Siberian species in the meadows and Palaearctic species in the other habitats. The communities from the meadows, sugar beet crop and hop crop demonstrated a peak of activity in August and the community from the wasteland had a peak of activity in June. These results, including low qualitative and qualitative-quantitative similarity between the communities, very low similarity of structures of dominance, and a large number of species of high fidelity, possibly indicate separate character of the individual communities studied.

Key words: *Coleoptera*, *Carabidae*, chernozem soils, hay meadows, sugar beet, hop, xerothermal wasteland.

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Introduction

In geographical terms, Roztocze (Kondracki 2000) is a macroregion situated in the subprovince of the Lublin-Lvov Uplands, and the province of the Polish Uplands. This range of hills extends from the north-west towards the south-east over approximately 180 km, at an altitude of 300-400 m. The earliest reports on carabid beetles in Roztocze can be found in papers by Nowicki (1858, 1864, 1870), and later by Łomnicki (1874, 1891, 1918), Mazur & Mazur (1924), Burakowski (1957), Burakowski et al. (1973, 1974), and Pawłowski (1974). A synopsis of the state of knowledge on the *Carabidae* of Roztocze is given in Rizun (1998). Huruk (2005) listed some more species new to this region. To date, papers by various Polish authors (those quoted above as well as others) have registered, in the Polish part of Roztocze, 252 species of *Carabidae*. However, none of these papers has analysed the structure of carabid communities in farm crops.

The aim of this paper was to characterise and compare carabid community structures in cultivated chernozem soils, including moist hay meadows (a meadow community with *Deschampsia caespitosa*) growing on chernozem soil, in a crop of sugar beet, hop and in a strip of xerothermal wasteland within the "Zamczysko" archaeological reserve. The characterisation involved identification and comparison of the quantitative and qualitative composition of individual communities, structures of dominance, frequency, ecological and zoogeographical characteristics, constancy, fidelity and activity of *Carabidae*.

Material and methods

Carabids were sampled in the village of Telatyn in Roztocze (Telatyn commune, at the Polish-Ukrainian border – Fig. 1) in moist hay meadows (a meadow community with *Deschampsia*

Fig.1. Location of study area

caespitosa), fields with crops of sugar beet and hop, and in a strip of xerothermal wasteland in the "Zamczysko" archaeological reserve.
Four permanent study sites were set up in each habitat for a total of 16 sites. *Carabidae* were collected in 1996 using Barber˙s pitfall traps (0.33l glass jars, with an aperture 58 mm in diameter) filled with glycol. Each study site had 6 traps buried in a line in the ground at 3 m intervals. Five monthly cycles of catches were carried out in each habitat, from May until the end of September.

The results are presented as numbers of individuals and species caught. Data on individuals caught are also presented using a trapability index corresponding to the number of carabids collected into one trap during 24 hours. Dominance is expressed as the percentage contribution of a species to the community (Górny & Grüm 1981). Ecological characteristics were based on the following papers: Larsson 1939; Lindroth 1945, 1949; Burakowski et al. 1973, 1974; Freude, Harde, Lohse 1976; Thiele 1977.

Species were classified as particular zoogeographical elements on the basis of Leśniak (1987). Similarity of communities was determined using the Marczewski-Steinhaus index (1959). Diversity was evaluated using Shannon˙s index of diversity (Weiner 1999), and evenness was measured using Pielou˙s index of evenness (Szujecki 1980). Zoogeographical similarity (P_z) of communities was calculated according to Marczewski˙s formula (Leśniak 1984): $P_z = W/200\text{-}W \times 100\%$, where W is the sum of smaller percentage shares in pairs of the same groups in the two habitats being compared. This formula was also used for the calculation of similarity of dominance structures (P_d), with "W" referring now to the sum of smaller percentage shares in pairs of the same species in the two habitats under comparison. Constancy of occurrence (C) was calculated as (Górny, Grüm 1981): $C = N_a/N$, where N_a is the number of samples containing a given species, and N is the total number of samples in a lot. Fidelity (F) was calculated as (Pawłowski 1967): $F = a/b \times 100$, where a is the abundance of a given species in the habitat variant under study, b= abundance of a given species in all habitat variants.

Results

Number of individuals and species

A total of 8581 *Carabidae* individuals were collected, representing 58 species (Tab. 1). A breakdown by habitat type is as follows: meadows: 4070 individuals and 36 species; sugar beet: 2380 individuals and 38 sspecies; hop 1831 individuals and 31 species; wasteland 228 individuals and 31 species.

Overall trapability was 0.59, with the following figures obtained for the individual habitats: meadow – 1.13; sugar beet – 0.66; hop – 0.51; wasteland – 0.06.

The highest carabid diversity was seen in the xerothermal wasteland ($H^{\cdot} = 3.8$) and the sugar beet community ($H^{\cdot} = 3,5$), with the lowest diversity obtained in the meadow community ($H^{\cdot} = 1.9$)(Tab. 1).

Qualitative similarity between communities was low, ranging from 42% (between the communities from the meadow and the sugar beet crop) to 55% (between the communities from the sugar beet crop and the wasteland)(Tab. 2). Qualitative-quantitative similarity was even lower (Tab. 3), with the meadow and wasteland communities coming out as the least similar (3%), and the sugar beet and hop communities as the most similar (33%).

Structures of dominance

In the meadow community *P. melanarius* and *P. cupreus* were eudominants, *H. rufipes* and *P. versicolor* were dominants, and the remaining 32 species were recedents (Ryc. 2). In the sugar beet community *H. rufipes* and *P. lepidus* were eudominants; *C. ambiguus*, *P. melanarius*, *P. cupreus* and *P. versicolor* were dominants; *Broscus cephalotes*, *C. erratus* and *C. fuscipes* were classified as subdominants; with the remain-

Tab. 1. Total catches and treatments administered (n-numberof individuals collected c-constancy, w-fidelity (%); pw-single exclusive species).

Lp	Species	Meadows			Sugar beet			Hop			Wasteland		
		n	c	w	n	c	w	n	c	w	n	c	w
1	C. granulatus L.	77			1								
2	C. cancellatus Ill.	20			6						54		64
3	C. hortensis L.	1		pw									
4	C. glabratus Payk.	1											
5	C. linnaei Duft.	1		pw									
6	Loricera caerulescens (L.)	2		100									
7	Broscus cephalotes (L.)				116	80	97	3					
8	Bembidion lampros (Herbst)	1			40		83	6					
9	B. quadrimaculatum (L.)	2			30			29					
10	Epaphius secalis (Payk.)	5		100									
11	Trechus quadristriatus (Schrank)				8			2					
12	Amara plebeja (Gyll.)	1			17						15		
13	A. aenea (De Geer)	4			2			3			1		
14	A. communis (Panz.)	2		67				1					
15	A. eyrinota (Panz.)										1		pw
16	A. famelica Zimm.				2		100						
17	A. similata (Gyll.)				1			12		92			
18	A. bifrons (Gyll.)				1		67				2		
19	A. ingenua (Duft.)							10		100			
20	A. consularis (Duft.)				3		56				1		
21	A. fulva (O.F.Müll.)							1		pw			
22	A. majuscula (Chaud.)				6		100						
23	A. aulica (Panz.)	5			9		53	1			2		
24	A. helleri Gredl.										1		pw
25	A. equestris (Duft.)	9						4			2		
26	Pterostichus versicolor (L.)	220	80	61	131			7			3		
27	P. cupreus (L.)	1354	95	85	142	75		96	60		3		
28	P. lepidus (O.F.Müll.)	3			486	55	97	3			2		
29	P. niger (Schall.)	5											
30	P. melanarius (L.)	2056	100	87	180	85		87			21		
31	Abax ater (Pill. et Mitt.)										3		100
32	Calathus ambiguus (Payk.)	1			207		87	25			2		
33	C. erratus (C.R. Sahlb.)	2			111		85	7			11		
34	C. fuscipes (Goeze)	1			104	55	69	38			8		
35	C. melanocephalus (L.)	5			22			18			2		
36	Dolichus halensis (Schall.)	2			5			47		85	1		
37	Synuchus nivalis (Panz.)	1			11			8					
38	Agonum gracilipes (Duft.)							1		pw			
39	A. dorsale (Pont.)				15		65	2			2		
40	A. fuliginosum (Panz.)	3			7		58	2					
41	Ch. nitidulus (Schrank)	9		100									
42	Ch. tibialis Dej.	3		100									
43	Anisodactylus binotatus (Fabr.)	10		91				1					
44	A. nemorivagus (Duft.)	7		75	1						1		
45	A. signatus (Panz.)	2			30			65		67			

46	Harpalus azureus (Fabr.)			1					2	67
47	H. punctatulus (Duft.)	1		2						
48	H. griseus (Panz.)			2		2			8	53
49	H. rufipes (De Geer)	245	70	625	95	1247	70	57	45	
50	H. calceatus (Duft.)	1				2		67		
51	H. affinis (Schrank)	6		38	60	38	60		1	
52	H. autumnalis (Duft.)			2					8	67
53	H. latus (L.)	1							2	67
54	H. psittaceus (Fourcr.)			7		59		87	2	
55	H. quadripunctatus Dej.			2					5	71
56	H. smaragdinus (Duft.)			1	pw					
57	Z. tenebrioides (Goeze)			6	67				3	
58	Z. spinipes (Fabr.)								14	
	TOTAL									
	species	36		38		31			31	
	individuals	4070		2380		1831			228	
	crop protection agents used									
insecticides		-		-		3x			-	
pesticides				2x		1x			-	
fungicides		-		-		4x			-	
	Fetiliser (kg NPK/ha)									
		51		683		620			-	

ing 29 species belonging to a group of recedents. In the carabid community of the hop crop *H. rufipes* was the only eudominant; *P. cupreus* was a dominant species; *P. melanarius, A. signatus, H. psittaceus, D. halensis, C. fuscipes* and *H. affinis* were subdominants; and 23 species were recedents. In the wasteland carabid comnmunity, *Carabus cancellatus* and *H. rufipes* were eudominants; *P. melanarius, A. plebeja* and *Z. spinipes* were dominants; *C. erratus, C. fuscipes, H. griseus, H. autumnalis* and *H. quadripunctatus* were subdominants; and there were 21 recedent species.

Pielou˙s index of evenness (J˙) was highest in the wasteland plot, and lowest in the meadow community (Fig. 2).

Similarity of dominance structures was low, ranging from 8.71% between the meadow and wasteland communities of *Carabidae* to 31.22% between the communities inhabiting the sugar beet and hop crops (Tab. 4).

Ecological characteristics

In terms of living environment, the dominant type was open area species (Tab. 5), with a high percentage of transitory elements (inhabiting both open and afforested areas) in the meadow community. In terms of feeding habits, large zoophages were dominant in the meadow community, small zoophages in the sugar beet crop, and hemizoophages in the hop crop and the wasteland (Tab. 5). The dominant breeding type was autumn breeders in all habitats.

Zoogeographical characteristics

Seven zoogeographical elements out of 8 reported from Poland were revealed in the material (Tab. 6). Qualitatively, the Palaearctic element was dominant in all habitats studied. In qualitative-quantitative analyses, Euro-Siberian elements were shown to be dominant in the meadow habitat and Palaearcitc elements predominated in the other habitats. Their dominance was particularly marked in the hop crop, where they had a share of 88.3 % of all individuals of the community.

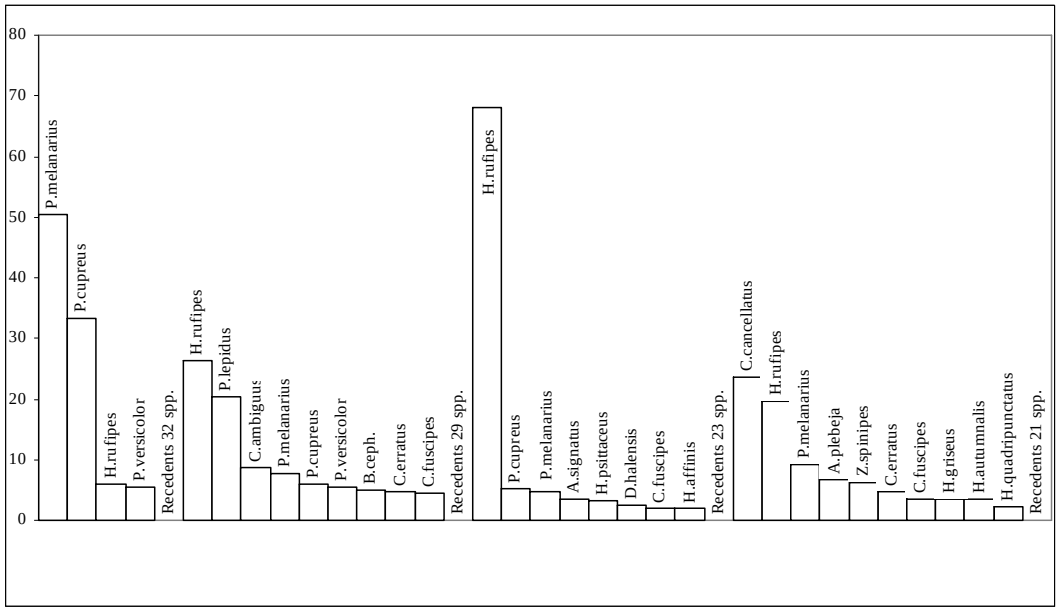

Fig. 2.Structure of dominance of *Carabidae* communities in the study habitats, with diversity index (H') and evenness index (J') (%-percentage of all individuals caught).

Seasonal activity of communities

The meadow and sugar beet communities of *Carabidae* demonstrated one peak of activity, in August (Fig. 3). The community from the hop crop had two peaks of activity: a main one in August and a minor one in May. Two very weak peaks of activity in June and in August were also observed in the community inhabiting the waste-land.

Species constancy and fidelity

Tab. 2. Qualitative similarity of communities (according to Jaccard's index, %).

	Meadows	Sugar beet	Hop	Wasteland
Meadows	X	42	49	36
Sugar beet		X	53	55
Hop			X	37
Wasteland				X

Tab. 3. Qualitative-quantitative similarity of communities (%, according to Beklemishev-Nefedov index).

	Meadows	Sugar beet	Hop	Wasteland
Meadows	X	13	9	3
Sugar beet		X	33	6
Hop			X	5
Wasteland				X

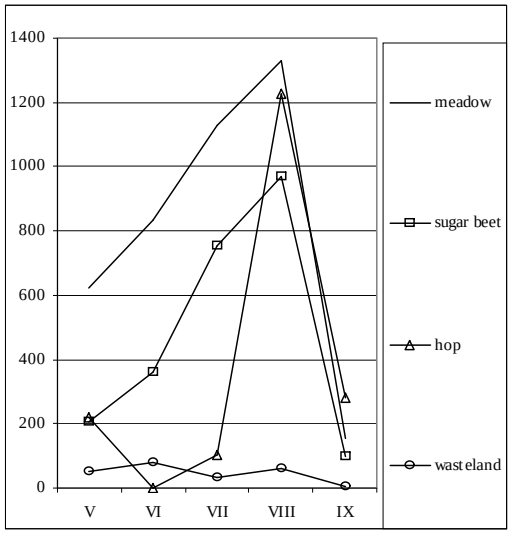

Fig. 3. Seasonal activity of communities in the study habitats N-number of individuals; V-IX time(months), from May (V) to September (IX)].

Tab. 4. Similarity of dominance structures.

X	Meadows	Sugar beet	Hop	Wasteland
Meadows	X	15.32	9.56	8.71
Sugar beet		X	31.22	28.49
Hop			X	20.84
Wasteland				X

An index of constancy, and particularly an index of fidelity can be helpful in establishing separate character of communities.

There were a few constant species associated with each habitat except the wasteland (Tab. 1). The most valuable ones were those which attained high constancy in a particular habitat and low constancy in the other habitats. However, very few species belonged to this group, including one in the meadow community and three in the sugar beet community.

In each habitat, however, there was a large number of species exhibiting high fidelity. More specifically, high-fidelity species represented by a large number of individuals were found in each of the habitats.

Discussion

On the whole, the study yielded abundant *Carabidae* material, which was due to the large number of habitats studied, while relative catch sizes were rather average. The trapability index was highest in the meadow, at 1.13; lower in the sugar beet crop, at 0.66; still lower in the hop crop 0.55 and lowest in the xerothermal wasteland.

The highest trapability was thus observed in a meadow, the habitat with apparently the least intensity of anthropogenic pressure. In that particular meadow, the pressure was limited to two occasions of mowing (at the end of May and at the turn of August) and very insignificant fertilisation (51 kg NPK/hectare). These practices, and particularly the mowing, probably did not adversely affect the numbers of individuals caught, which rose vigorously from May till August. Mowing could be regarded as a rather unwelcome procedure since it does radically change the heat, moisture and insolation conditions in this habitat for a period of time. The abundance figures suggest that the mowing of this meadow did not probably adversely affect *Carabidae* and the trapability index can be considered high.

Tab. 5. Shares of different ecological elements in communities (N-number of individuals, %-percentage shares).

Ecological element	Meadow		Sugar beet		Hop		Wasteland	
	N	%	N	%	N	%	N	%
Category: living environment								
Forest	13	0.32	39	1.64	67	3.66	8	3.51
Transitional	1438	35.33	163	6.85	163	8.90	5	2.19
Open-area	2619	64.35	2178	91.51	1601	87.44	215	94.3
Category: feeding habits								
Large zoophages	2161	53.10	187	7.86	87	4.75	78	34.21
Small zoophages	279	6.86	1330	55.88	268	14.64	49	21.49
Hemizoophages	1630	40.05	863	36.26	1476	80.61	101	44.30
Category: breeding type								
Spring breeders	1739	42.73	435	18.28	252	13.76	113	49.56
Autumn breeders	2331	57.27	1939	81.47	1579	86.24	114	50.00

Tab. 6. Shares of different zoogeographic elements in communities [qualitative (S) and quantitative (N). %].

Ecological element	Meadow		Sugar beet		Hop		Wasteland	
	S	N	S	N	S	N	S	N
Holarctic	5.55	0.10	2.63	1.26	3.23	1.58		
Palaearctic	52.78	40.73	63.15	57.98	70.96	88.31	67.74	52.63
Euro-Siberian	22.22	58.59	26.31	39.37	22.58	6.55	16.13	35.52
Euro-Arctic	2.78	0.02						
Euro-Mediterranean	8.33	0.29	5.26	1.30	3.23	3.55	6.45	6.58
European Forest Province	5.55	0.24	2.63	0.08			9.68	5.26
European Forest Province (montane)	2.78	0.02						

A paper by Handke (1955) reported a trapability index of 0.50 in wet meadows; 0.66 in mesophilous meadows; and 0.51 in periodically waterlogged meadows. A trapability of 0.11 has been reported for a meadow along the Nida River (Huruk 2003), and 0.54 for a meadow along the San River (Huruk 2004). All these values are lower than the figure obtained in the present study. When trying to interpret the difference, one should quote Czechowski˙s (1989) information, stating that the abundance of *Carabidae* may fall, for example, as the intensity of exploitation of meadows increases. Thus, the high trapability may point to less intense meadow usage in the area of study.

Trapability was lower, below 1, in the crop fields compared with the meadow. In the sugar beet crop, trapability was 1.6 times lower, and in the hop crop 2.2 times lower than in the meadow. This was evidently due to some negative factors strongly affecting the *Carabidae* communities in the crop fields. These negative factors certainly involved mechanical practices (ploughing, harrowing, cultivator use etc.), intense fertilisation and the use of crop protection agents. The latter was particularly intense in the hop crop, which was sprayed eight times, including three occasions of insecticide spraying. This probably affected carabid trapability in the hop crop as the trapability figures there were the lowest of all cultivated fields studied (meadows, sugar beet, hop) as were the numbers of species caught. Trapability values can vary significantly in fields, from very low values – 0.21 (Pawłowa 1976), to high and very high – 13.6 (Pałosz 2001); 23.9 (Tamutis et al. 2004).

The wasteland carabid community represents a particularly interesting finding, with trapability even lower than in the cultivated areas, and the number of species the same as in the hop crop, although, as indicated earlier, that crop was subjected to the most intense plant protection procedures.

What factor underlies such a marked fall in trapability and reduction in species numbers in the xerothermal wasteland? It is certainly the permanent water deficit. This is indicated by a very marked dominance of *H. rufipes*, a ubiquitous, thermophilous species, which some authors even call xerophilous (Koch 1989). The low trapability may also be due to scarcity of food. Studies of *Carabidae* inhabiting steppe areas that were ploughed and used for farming indicate that carabid abundance in fields increases together with the number of species (species typical of the steppe disappear but there are new species that were not present when the area was a steppe) (Arnoldi et al. 1972). The present findings represent the reverse case of an area that is no longer cultivated. This should lead to a reduction in trapability and species numbers. Trapability in the wasteland was indeed drastically lower compared to the meadows, or sugar beet and hop crops. The number of species caught was also the smallest (as low as in the hop community).
The numbers of species caught do not appear to deviate from other authors˙ results, with an aver-

age of 24.92 species caught in cultivated fields in Eastern and central Europe during one growing season (Luff 2002).

The group of dominant species consisted of *C. cancellatus A. plebeja P. versicolor P. cupreus P. lepidus P. melanarius C. ambiguus H. rufipes* and *Z. spinipes*. These species are commonly dominant in European fields (Kabacik 1962, Arnoldi 1972, Vasiljeva 1972, Popova 1982, Volkova 1990, Pałosz 1998, Huruk 2000, Sobolева-Dokuchaeva et al. 2000, Pałosz 2001, Aleksandrowicz 2002, Luff 2002, Tamutis 2004). Patterns of distribution of individuals among species varied, with the greatest evenness of distribution in the wasteland community (J˙ = 0.76), and the least in the meadow community (J˙ = 0.36). It appears that the most uniform distribution of individuals among species in the carabid community inhabiting the wasteland is due to the very harsh living conditions there, making it impossible for any species to dominate the community. The finding of the least even distribution of individuals in the meadow community of carabids may be due to the specific features of that habitat (considerable moisture over prolonged periods; complete exposure of soil as a result of mowing, which changes habitat conditions suddenly and radically). There are not too many species able to tolerate such conditions. Such species should dominate the community numerically. In the present study, individuals belonging to the four eudominant and dominant species of the meadow community accounted for 95.2% of this carabid community, while the remaining 4.8% was shared by individuals of 32 species. Thus, the distribution of individuals among species was very uneven (J˙ = 0.36) in this community as well as in the community inhabiting the hop crop (J˙ = 0.43).

The dominance of the specific ecological elements in particular communities does not appear surprising. The finding of a large share of transitional elements, i.e. those that inhabit both open-area and afforested habitats, in the meadow communities is interesting, but it is known that fields may support numerous species whose primary biotopes are forest, water˙s edges and sites with scarce vegetation (Tischler 1971).

A zoogeographical analysis revealed a predominance of Euro-Siberian elements in the meadow community and Palaearctic elements in the other habitats. It may be caused by stronger pressures from negative factors on *Carabidae* in cultivated fields. A growing share of widely distributed species with increasing negative pressures was noted by Leśniak (1997).

The carabid communities generally had a main peak of activity in August, indicating a predominance of autumn breeders, which exhibit peak activity in the second half of the growing season. This finding is a confirmation of what has been known for a long time: numerical predominance of autumn breeders in fields (Górny 1968, 1971).

The study˙s results, including low qualitative and qualitative-quantitative similarity of communities, very low similarity of structures of dominance and a large number of high-fidelity species may attest to a separate character of the communities under study. It should be pointed out that the crops were grown on the same type of soil, which indicates a dominant impact of the crop itself on *Carabidae* communities. However, it should also be taken into account that the habitats sampled (crops vs. wasteland) were so distinct from one another that the dissimilarity of the associated carabid communities should be taken for granted.

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FAUNA OF GROUND-BEETLES (COLEOPTERA: CARABIDAE) IN THE SANDY AGROCENOZIS OF STROPI (DAUGAVPILS, LATVIA)

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Bukejs A. 2005. Fauna of ground-beetles (Coleoptera: Carabidae) in the sandy agrocenozis of Stropi (Daugavpils, Latvia). *Acta Biol. Univ. Daugavp., 5 (1): 23 - 26.*

The fauna of ground-beetles in the sandy agrocenozis of Stropi (Daugavpils district) was studied with the help of pit-fall traps. During 5 years of research 2144 samples of ground-beetles were collected and 64 species belonging to 24 genera were stated. A greater number of species represent genera *Amara* (13) and *Harpalus* (12). Dominant species of ground-beetles in the sandy agrocenozis are *Harpalus rufipes* Deg., *H. tardus* Pz., *H. affinis* Schrnk., *Amara fulva* Deg. and *A. familiaris* Duft.

Key words: Carabidae, fauna, sandy agrocenozis, Stropi, Daugavpils, Latvia.

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Introduction

Though faunistic research of beetles in Latvia is intensive, there is not enough information about the fauna of ground-beetles in agrocenozis and publications mainly concern central and western parts of Latvia (Cinītis 1962, 1975; Skaldere 1981; Petrova, Barševskis, Čudare 2005). Only in A. Barševskis' (1987, 1993) publications one can find information about the agrocenozis fauna of ground-beetles in eastern Latvia. Our research is thorough, profound and it's an essential addition to the already made study of the problem.

Material and methods

The research of the ground-beetle fauna took place in the sandy agrocenozis of Daugavpils district, Stropi. It lasted for 5 years, since 2000 till 2004 (June – September). The area of the agrocenozys being studied is approximately 2,0 hectares. The fields of different such as potatoes, cabbages, cereals (rye, oats) and strawberries can be found in the agrocenozis and it borders on xerophyte meadows and leaf-bearing forest *Alnus incana* L. and *Betula pendula* Roth. are typical.

The main method of research were pit-fall traps containing 3-4% acetic acid solution. The traps were examined once a week. The material was collected as well while examining biotope (under different objects, on soil, on plants. etc.).

The characteristic types of biotopes for ground-beetles were defined according to A. Barševskis' (2003) system.

Results

While studying the sandy agrocenozis of Stropi (Daugavpils district) 2144 samples of ground-beetles were collected. 64 species of beetles (which makes 19,63% of total member known in Latvia) belonging to 24 genera (Table) were stated. Typical species for the given sandy agrocenozis are the following: *Harpalus rufipes* Deg. – 442 samples (20,62%), *H. tardus* Pz. – 369 samples (17,21%), *H. affinis* Schrnk. – 223 samples (10,40%), *Amara fulva* Deg. – 163 samples (7,60%) and *A. familiaris* Duft. – 125 samples (5,83%).

The results of other research were similar. E. Ozols (Īēīèń 1956) found 48 species of ground-beetles in cereal fields with sandy soil. R. Cinītis (1975) writes about *Harpalus rufipes* Deg. as a dominating type among cross-flowered in Salaspils, Babīte, Carnikava and Ādaži. Such species as *Harpalus affinis* Schrnk., *Amara fulva* Deg., *Bembidion quadrimaculatum* L. and others were often found too. S. Skaldere (Ńźąėääšå 1981) in barley agrocenozis mentions *Harpalus rufipes* Deg. as one of the prevailing species.

Species characteristic for other types of biotops were noted as well: *Carabus granulatus* L. and other typical for bushes; *Synuchus vivalis* Ill. and others typical for be seen in forest and open biotops; *Carabus hortensis* L., *Harpalus latus* L. and others are typical forest biotops (Tabel 1). The presence of species characteristic for other biotops in the different near-by biotops: xerophit meadows, bushes and leaf-bearing forest.

Higrophil species of *Cychrus caraboides* L. (2 samples), *Acupalpus meridianus* L. (1), *Asaphidion flavipes* L. (3) and *Bembidion bruxellense* Wesm. (1), which usually appear in damp biotops, were also discovered. The existence of these species in a non-typical habitat can be probably explained by cool and rainy weather when the soil of the agrocenozis was relatively damp.

Representatives of 24 genera of ground-beetles were caught in the sandy agrocenozis of Stropi: 13 of *Amara* genus and 12 of *Harpalus* genus. It‘s because the species of these genera mainly live in sandy soil and open biotops. Representa-

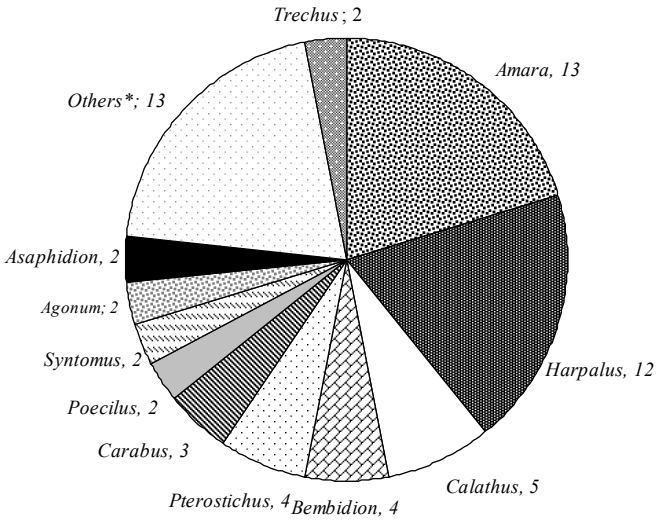

Figure 1. Genus and numer of species found on the sandy agrocenozis of Stropi (Daugavpils district). *Others: *Cicindela*, *Leistus*, *Clivina*, *Ophonus*, *Lebia*, *Masoreus*, *Microlestes*, *Anchromenus*, *Broscus*, *Synuchus*, *Cychrus*, *Acupalpus* and *Anisodactylus*.

Species	Specimens	Habitats
Cicindela hybrida L.	3	OaF, Rp
Leistus terminatus Hell.	1	OaF
Carabus granulatus L.	4	OaF
C. cancellatus Ill.	1	OaF
C. hortensis L.	2	F
Cychrus caraboides L.	2	F
Clivina fossor L.	13	Oa
Broscus cephalotes L.	56	Oa
Trechus quadristriatus Schrnk.	10	OaF
T. secalis Pk.	3	OaF
Asaphidion flavipes L.	3	OaF, Rp
A. pallipes Duft.	10	OaF, Rp
Bembidion lampros Hrbst.	11	OaF
B. gilvipes Strm.	1	OaF, Rp
B. quadrimaculatum L.	30	OaF
B. bruxellense Wesm.	1	Oa, Rp
Anchromenus dorsalis Pont.	5	Oa
Agonum sexpunctatum L.	2	OaF, Rp
A. viduum Pz.	1	Oa, Rp
Calathus fuscipes Gz.	38	Oa
C. erratus Sahl.	60	OaF
C. ambiguus Pk.	70	Oa
C. micropterus Duft.	17	F
C. melanocephalus L.	62	OaF
Synuchus vivalis Ill.	1	OaF
Poecilus versicolor Strm.	7	OaF
P. cupreus L.	19	OaF
Pterostichus melanarius Ill.	4	OaF
P. oblongopunctatus F.	1	F
P. niger Schll.	13	OaF
P. strenuus Pz.	1	OaF
Amara aenea Deg.	22	OaF
A. spreta Dej.	3	OaF
A. similata Gyll.	5	OaF
A. lucida Duft.	1	Oa
A. familiaris Duft.	125	OaF
A. nitida Strm.	1	OaF
A. convexior Stph.	1	Oa
A. bifrons Gyll.	66	Oa
A. fulva Deg.	163	Oa
A. consularis Duft.	66	Oa
A. apricaria Payk.	28	Oa
A. majuscula Chaud.	46	Oa
A. aulica Pz.	1	Oa
Ophonus rufibarbis F.	2	OaF
Harpalus griseus Pz.	43	Oa
H. rufipes Deg.	442	Oa
H. calceatus Duft.	2	Oa
H. affinis Schrnk.	223	Oa
H. smaragdinus Duft.	48	Oa
H. laevipes Zett.	1	F
H. latus L.	1	F
H. anxius Duft.	1	OaF
H. tardus Pz.	369	Oa
H. picipennis Duft.	1	Oa
H. froelichii Strm.	4	Oa
H. hirtipes Pz.	1	Oa
Anisodactylus binotatus F.	1	OaF, Rp
Acupalpus meridianus L.	1	OaF
Masoreus wetterhalli Gyll.	7	Oa
Lebia cruxminor L.	1	Oa
Syntomus truncatellus L.	9	OaF
S. foveatus Frcr.	6	Oa
Microlestes maurus Strm.	1	Oa

tives of other genera were a little bit fewer (Fig. 1).

As a result of the research rare species of ground-beetles were discovered: *Amara convexior* Stph. (1 sample), *Harpalus froelichii* Strm. (4), *H. anxius* Duft. (1), *H. hirtipes* Pz. (1), H. *calceatus* Duft. (2) and *Masoreus wetterhalli* Gyll. (7). These species are connected with different sandy biotops.

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OCCURRENCE AND BIODIVERSITY OF WEEVILS (COLEOPTERA, CURCULIONOIDEA) ON STRAWBERRY AND OBSERVATIONS OF THE BLOSSOM WEEVIL (*ANTHONOMUS RUBI* HBST) DAMAGE TO 13 STRAWBERRY CULTIVARS

Valentīna Petrova, Zigrīda Čudare, Valda Laugale, Līga Jankevica

Petrova V., Čudare L., Laugale V., Jankevica L. 2005. Occurrence and biodiversity of weevils (Coleoptera, Curculionoidea) on strawberry and observations of the blossom weevil (*Anthonomus rubi* Hbst) damage to 13 strawberry cultivars. *Acta Biol. Univ. Daugavp., 5 (1): 27 - 34.*

A list of Curculionoidea (of 3 families) species found on cultivated strawberry in Latvia has been made according to previous publications, and the collections of the authors (1997-2001). In Latvia 16 weevil species were registered in strawberry fields. The eleven weevil species are found during investigation period 1997-2004. The nine species from these were registered for the first time on strawberries in Latvia: *Ceuthorhynchus floralis* (Payk., 1975), *Neocoenorrhinus virens* (Hbst., 1797), *Chlorophanus viridis* (L., 1758), *Hypera* spp., *Phyllobius maculicornis* Germ., 1824, *Rhinoncus bruchoides* (Hbst., 1784), *Sitona lineatus* (L., 1758), *Tychyus picirostris* (F., 1787), *Compsapoderus erythropterus* (Gmelin, 1790). The susceptibility of 13 strawberry cultivars to the blossom weevil, *Anthonomus rubi* (Hbst., 1795), was evaluated in 2001-2002. Significant differences between the cultivars were found. The highest amount of damaged buds (10%) was noted on cultivar Bargerglow in 2001 and on cultivar Lihamma (11%) in 2002. Damaged buds were not found on cultivars Polka, Rhapsody, Syriusz and Senga Sengana in 2001 and on cultivars Marmolada and Senga Sengana in 2002.

Key words: weevils, strawberry, resistance, *Anthonomus rubi,* Curculionidae

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Introduction

The electronically catalogue of Latvian invertebrates check-list of Latvian weevils (reviewed in 2003) included about 400 of native weevil species (Telnov et al. 1997-2003).

Before our study on strawberry seven weevil species were mentioned in Latvia: *Anthonomus rubi* (Hbst., 1795), *Otiorhynchus ovatus* (L., 1758), *O. ligustici* L., 1758, *Phylopedon plagiatus* (Schall., 1959), *Phyllobius pomaceus* Gyll., 1834, *Ph. argentatus* L., 1758, and *Pselaphorhynchites*

germanicus (Hbst., 1797) (Sudrabs 1942, Ozols 1973, Priedītis 1996).

Injurious species of Curculionoidea are distributed throughout where are strawberry growing areas. They attack and feed on fruitful organs, on leaves and roots. The strawberry blossom weevil *A. rubi* is considered as one of the main from them. *Anthonomus rubi* cause severe damage to flower buds on strawberry in many European countries as England (Cross & Ēasterbrook 1998), Austria (Blümel 1998), Finland (Tuovinen & Parikka 1997), Germany (Müller 1987), Poland (Łabanowska & Bielenin 2002), Russia (Savzdarg 1960), and others. In Latvia Sudrabs (1942) mentioned that the weevil *A. rubi* might reduce to 75% of strawberry yield.

Weevils *O. ovatus O. ligustici, Ph. pomaceus Ph. plagiatus, Ph. argentatus* and *P. germanicus* also are broadly distributed strawberry pests in many European countries (Kryzhanowskij 1974, Müller 1987, Łabanowska & Bielenin 2002, and others).

The aim of this study was to determine weevil compound, occurring on cultivated strawberry, to evaluate the injury level of the strawberry blossom weevil, and the susceptibility of 13 strawberry cultivars to the *A. rubi* in Latvian climatic conditions.

Material and Methods

The material was collected on commercial strawberry fields in the Pure Horticultural Research Station (Tukums Region) located in the northwest of Latvia. The inspected area is situated on soda calcareous podzolized, sandy loam soil on dolomite bedrock.

The all investigations were carried out on fields where any insecticides were not applied. Weevil fauna was investigated in 1998-2004. Direct observations, collection from leaves, sweep netting and pitfall traps were used to study the weevils. The monitoring of weevil adults (*Anthonomus rubi*) was carried out with sweep net monthly from May to October in season 1999, and from July to September in 2000. One sample included material from 200 sweeps made along the longitudinal axis of the investigated field. The taxonomy of weevils was based on checklist of Latvian beetles (Telnov et al. 1997-2003). Fifty inflorescences were randomly collected from 50 plants per field (on 3 years old planting) during strawberry blooming period on June 8, 1999 to specify injuries of the strawberry blossom weevil. The flower buds were inspected and classified as healthy or injured by *A. rubi*.

Thirteen strawberry cultivars: Melody, Polka, Marmolada, Gerida, Rhapsody, Lihamma, Lvovskaya Rannaya, Wega,

Table 1. List of weevil species from strawberry investigated in Latvia.

Species / Family	Registered	
	Before 1996	1997-2004
Curculionidae		
Anthonomus rubi (Hbst., 1795)	+	+
Ceuthorhynchus floralis (Payk., 1792)	–	+
Chlorophanus viridis (L., 1758)	–	+
Hypera spp.	–	+
Otiorhynchus ligustici (L., 1758)	+	–
Otiorhynchus ovatus (L., 1758)	+	+
Philopedon plagiatus (Schall., 1959)	+	–
Phyllobius argentatus (L., 1758)	+	–
Phyllobius maculicornis Germ., 1824	–	+
Phyllobius pomaceus Gyll., 1834	+	+
Rhinoncus bruchoides (Hbst, 1784)	–	+
Sitona lineatus (L., 1758)	–	+
Tychyus picirostris (F., 1787)	–	+
Apionidae		
Neocoenorrhinus virens (Hbst., 1797)	–	+
Attelabidae		
Pselaphorhynchites germanicus (Hbst., 1797)	+	–
Compsapoderus erythropterus (Gmelin, 1790)	–	+
Totally:	**7**	**12**

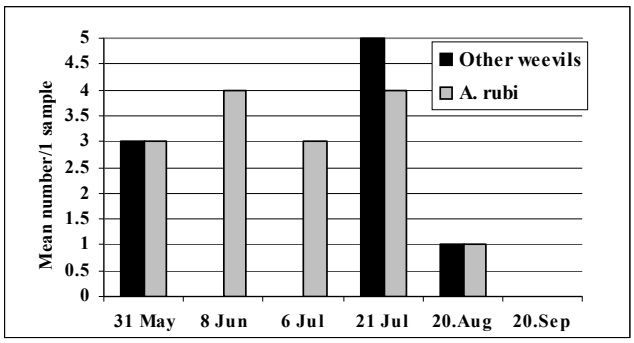

Fig. 1. Mean numbers of *A. rubi* and other weevil species indviduals (per 200 sweeps) collected during sampling period in 1999 on 3-years old strawberry.

LPR-805-4, Bargerglow, Syriusz, Senga Sengana and Zefyr, were inspected for damage of strawberry blossom weevil in 2001-2002 during maximum of strawberry blossoming. Plants were planted in the middle of September 1999 in single rows with spacing 30x100 cm. Any mulching and spraying against pests were not used. The whole number and number of blossom weevil damaged flower buds on one row meter in four replications for each cultivar were counted. The percentage of damaged buds was calculated. Results were analysed using analysis of variance, significance level 95%. Percentage data were converted with arcsine transformation. Duncan's multiple range tests were done for statistical comparison among cultivars. The meteorological data were obtained from Regional Meteorological Station located near Pure Horticultural Research Station.

Results

During investigations (1998-2004) 12 weevil species belonging to 3 families (Curculionidae, Attelabidae and Apionidae) were collected on

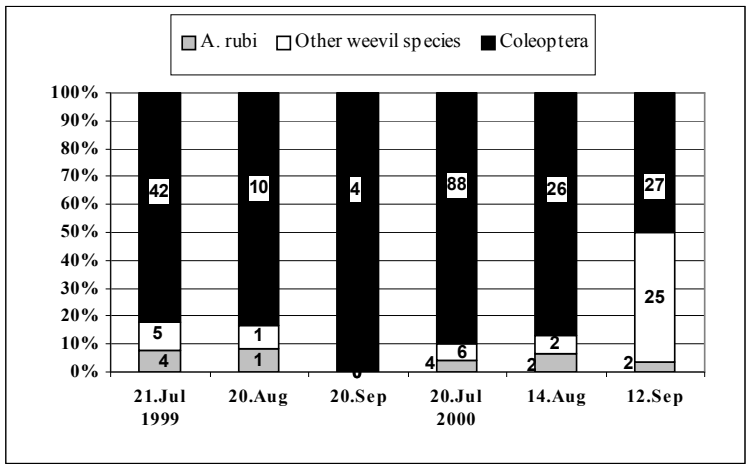

Fig. 2. Comparative abundance of Coleoptera beetles, the weevils and A. rubi beetles (per 200 sweeps) in 1999 (3 years old strawberry) and 2000 (1 year old strawberry)

Table 2. Percent of strawberry buds damaged by the blossom weevil (*A. rubi*) on different strawberry cultivars in 2001, 2002.

Cultivar	2001	2002	Average of 2 years
Melody	4,62% c	5,50% bcd	5,50% efg
Polka	0,00% a	0,22% a	0,10% b
Marmolada	1,70% b	0,00% a	0,95% bc
Gerida	0,81% b	8,69% d	4,23% defg
Rhapsody	0,00% a	4,99% bcd	1,66% cd
Lihamma Lvovskaya	4,53% c	10,69% d	7,42% fg
Rannaya	1,74% b	8,31% cd	6,18% fg
Wega	1,40% b	6,20% bcd	3,73% def
LPR-805-4	2,32% bc	1,66% abc	2,46% cde
Bargerglow	10,07% d	6,89% bcd	8,43% g
Syriusz	0,00% a	1,65% ab	1,65% cd
Senga Sengana	0,00% a	0,00% a	0,00% a
Zefyr	2,25% bc	6,37% bcd	4,24% defg

Means separated by Duncan's multiple range test within columns. Values in a column followed by the same letter do not differ significantly (P= 0,05).

strawberry (Table 1). 83,3% of the species belonged to the Curculionidae family (10 species from total). Only one species *Neocoenorrhinus virens* (Hbst, 1797) related to the family Apionidae and one species *Compsapoderus erythropterus* (Gmelin, 1790) - to Attelabidae.

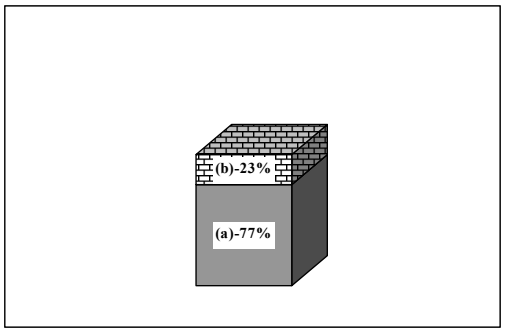

Fig. 3. Percentage of flower buds damaged by *A. rubi* (7 June 1999); (a) –buds contained egg or larvae of weevil, (b) – buds only punctured by weevil.

The most frequent weevil species were *A. rubi*, *Ch. viridis*, *O. ovatus, Ph. pomaceus*, *Ph. maculicornis*, *S. lineatus*. These species occurred each year during the period of the study. The nine species were registered for the first time on strawberries in Latvia: *C. floralis*, *Ch. viridis*, *Hypera* sp., *N. virens*, *Ph. maculicornis*, *Rh. bruchoides*, *S. lineatus*, *T. picirostris, C. erythropterus*. All these species occurred in small numbers and damage level to strawberry plants was insignificant. All weevils that were collected from strawberry serious damages did not cause in investigated area during 1996-2004, except the blossom weevil, *A. rubi*.

Our observations showed that the blossom weevil damaged flower buds in variable extent depending on year and cultivar. The monitoring of weevils that was carried out in season 1999 (Fig. 1) showed that *A. rubi* was abundant in all sweet net samples in this year. In May 31 amount of *A. rubi* adults was 66.7% from total collected weevils, July 21 – 80%, but June 8, July 6 and August 20 – 100%. The largest number of specimens (in average 4 weevils per sample) was observed in June 8 and July 21. The last time *A. rubi* was trapped by sweep net in August 20 (in average 1 weevil per sample).

In the Figure 2 the total number of coleopterans, weevils (also only the blossom weevils) trapped in 1999 and 2000 from July to September is shown. It was established that all these indices in 1999 were significantly less than in 2000. In 1999 the percentage of weevils was in average 12% from total amount of Coleoptera and respectively, in July – 21.1% in August – 20% and 0% in September, but in 2000 in July – 6.8%, in August – 7.7%, and September – 92.6%.

In July 20, 2000 the number of *A. rubi* adult composed 66.7% from total trapped weevils, in August 14 – 100% and September 12 – 8%, respectively. In 2000 the September was the last month when *A. rubi* was trapped by sweep net (in average 2 weevils per sample).

In the June 8, 1999 damage level of the strawberry blossom weevil was estimated on three

Table 3. List of common Holarctic weevil and species caused damages to strawberry

Family	Species	Damage			Location	Author
		Leaf	Root	Fruitful organs		
Curculionidae	*Anthonomus rubi* (Hbst.)			+	Europe, Russia	Križanovsky, 1974
	Barypeithes araneiformis (Schrnk.)			+	Middle Europe, Russia	Križanovsky, 1974
	Barypeithes mollicomus (Ahrens)			+	West Europe, Russia	Križanovsky, 1974
	Eusomus beckeri Tourn.	+			Hungary, Bulgaria, Russia	Križanovsky, 1974
	Otiorhynchus clavipes Bonsd.	+	+		Europe, Russia	Križanovsky, 1974
	Otiorhynchus ligustici (L.)	+	+		Europe, Russia	Križanovsky, 1974
	Otiorhynchus ovatus (L.)	+	+		Europe, North America, Mid. Asia	Križanovsky, 1974; Maas, 1998
	Otiorhynchus raucus (F.)	+			West Europe, Russia	Križanovsky, 1974
	Otiorhynchus rugifrons (Gyll.)	+	+		Europe, North America, Russia	Križanovsky, 1974
	Otiorhynchus rugosostriatus (Goeze)	+	+		Europe, USA, Russia	Križanovsky, 1974
	Otiorhynchus sulcatus (F.)	+	+		Europe, Russia, North America	Križanovsky, 1974; Maas, 1998
	Phyllobius arborator (Hbst.)	+			West Europe, Russia	Križanovsky, 1974
	Phyllobius argentatus (L.)	+			West Europe, Russia	Križanovsky, 1974
	Phyllobius calcaratus (F.)	+		+	Middle Europe, Russia	Križanovsky, 1974
	Phyllobius maculicornis Germ.	+			West Europe, Russia	Križanovsky, 1974
	Phyllobius oblongus (L.)	+		+	West Europe, Russia	Križanovsky, 1974
	Phyllobius pomaceus Gyll.	+	+		West Europe, Russia	Križanovsky, 1974
	Phyllobius viridicollis (F.)	+			West Europe, Russia	Križanovsky, 1974
	Philopedon plagiatus (Schall.)	+			West Europe, Russia, North China	Križanovsky, 1974
	Polydrusus sericeus Schall.	+			West Europe, Russia	Križanovsky, 1974
	Chlorophanus viridis (L.)	+			West Europe, Russia	Križanovsky, 1974
	Sciaphilus asperatus (Bonsd.)	+	+		Europe, Russia	Križanovsky, 1974
Attelabidae	*Rhynchites interpunctatus* (Steph.)	+			Middle Europe, Russia	Križanovsky, 1974
	Pselaphorhynchites germanicus (Hbst.)	+		+	West Europe, Russia	Križanovsky, 1974

years old planting. After inspection of 317 flower buds from 50 inflorescences it was established that in average 38.8 % of inflorescences (from total) had damaged buds and A. *rubi* destroyed 17% of flower buds (from total). The inspection of damaged buds also showed that 77% of buds contained the larval and embryonic stages of weevil and 23% of flower buds were only punctured (Fig. 3). 8.3% of total buds with larvae had two larvae into the one bud.

In the testing of strawberry cultivars for susceptibility to strawberry blossom weevil significantly different results among cultivars were obtained. In 2001 the percent of blossom weevil damaged buds fluctuated from 0 to 10% (from total) depending on cultivar. Damaged buds were not found only on cultivars Polka, Rhapsody, Syriusz and Senga Sengana (Table 2). Rather low damage level had also cultivars Marmolada, Gerida, Lvovskaya Rannaya and Zefyr (1-2% from total). The highest amount of damaged buds (10% from total) was noted on cultivar Bargerglow.

In 2002 the amount of blossom weevil damaged buds fluctuated from 0 to 11% (from total) depending on cultivar (Table 2). The highest amount of damaged buds was noted on cultivar Lihamma (11% from total). Damaged buds were not found on cultivars Marmolada and Senga Sengana and just some buds on cultivar Polka.

In average of two years the highest resistance to blossom weevil showed cultivar Senga Sengana, which had no damaged buds in both testing years. Rather high resistance showed also cultivars Polka, Marmolada, Syriusz and Rhapsody (lower than 2% of damaged buds). The most susceptible between tested cultivars was Bargerglow. More than 5% of damaged buds had also cultivars Melody, Lihamma and Lvovskaya Rannaya.

Discussion

Among the strawberry root pests detected on strawberry in Latvia, the strawberry root weevil, *O. ovatus* and the black vine weevil, *O. sulcatus* are serious pests in Europe, North America, Russia (Table 3) (Savzdarg 1960, Kryzhanowskij 1974, Maas 1998). E.Ozols (1973) reported that the wee-

vils *O. ovatus* and *O. ligustici* occurred and damaged cultivated strawberry roots in Latvia annually. A.Rupais (1999) mentioned that *O. sulcatus* caused damage to outdoor roses in the Latvian nurseries in some years.

Ph. pomaceus, Ph. argentatus, *Ph. maculicornis, Ph. plagiatus, Ch. viridis*, and *P. germanicus* were from weevils detected on strawberry in Latvia and belonging to category of common strawberry pests caused damage to leaves (Table 3).

The leaf weevil *Ph. pomaceus* was found yearly during our study. It is known as polyphagous species that is widely distributed on strawberry in Europe. *Ph. pomaceus* was widely distributed in Latvia before 60th as foliage pest into strawberry cenosis (Ozols 1973). E. Savzdarg (1960) mentioned that only one female and one male of this species might eat about 31-35cm² of leaf surface during 37-42 days (larvae cause damage to root).

The species *Ph. maculicornis* founded during our study is known as widely distributed strawberry leaf weevil in Europe (Kryzhanowskij, 1974). The species *Ch. viridis* is known as strawberry pest in West Europe and Russia (Kryzhanowskij 1974). This species was observed as leaf pest on apple and fruit trees in south part of central Latvia (Križus 1956).

The species *Ph. argentatus*, *Ph. plagiatus* and *P. germanicus* that were not found during our investigation are the strawberry leaf pests in West Europe, Russia, and North China (Kryzhanowskij 1974). *Ph. plagiatus* was attacked strawberry in Riga Region (Latvia, Salaspils) in 1959 (Ozols 1973). *P. germanicus* was observed in the strawberry growing areas of Jelgava Region (Latvia) in 1943 and caused injury to strawberry leaves and inflorescence stems (Ozols 1973).

N. virens, *Rh. bruchoides, S. lineatus* and *T. picirostris,* are known as widely distributed pests on Fabaceae family plants (Kryzhanowskij 1974), and faster are occasional species on strawberry. *C. floralis* is known as Cruciferae family crop pest caused injury to seeds and (Kryzhanowskij 1974), and also occurred on strawberry occasionally.

Strawberry blossom weevil *A. rubi,* is widely distributed in Europe, Russia. In Latvia observed on strawberry, raspberry, blackberry and *Rosa pimpinellifoli* L (Rupais 1999).

There is lack of information about different strawberry cultivar resistance to *A. rubi* in the literature. Insecticides usually successfully control this pest. Though it can cause serious problems in organic farming. The weevil *A. rubi* in Poland and Sweden may damage from a few up to 60% of strawberry buds (Łabanowska 1997, Svensson 2002). In Estonia the greatest injuries were observed in 1983-1987 when 25-36.4% of flower buds were damaged, but at the beginning of 1994 the injury reduced by 5% (Kikas & Libek 2002).

A. rubi caused difficulties in Latvia before 60th. In some years *A. rubi* was damaged up to 50% of flower buds and caused significant problems to the most of Latvian growers in the strawberry growing areas at the Baltic Sea Coast (Ozols 1973).

According to the previous investigations, the occurrence of strawberry blossom weevil can vary greatly between years, fields and cultivars (Tuovinen & Parikka 1997, Simpson et al. 1997, Kikas & Libek 2002).

It was confirmed by our investigations too. In our study (1999-2001) the *A. rubi* injury level on strawberry fluctuated from 0 to 17% varied on the cultivar and between years. In prevalence more damaged buds were observed on early flowering cultivars as Lvovskaya Rannaya, Lihamma and Bargerglow, while other early flowering cultivars as Wega and Zefyr had less blossom weevil damages than later flowering cultivar Melody. Rhapsody, which started flowering very late, had significantly higher percent of damaged buds than other early flowering cultivars as Polka and Senga Sengana. Simpson et al. (1997) suggests that the proportion of damaged buds is

not merely a function of flowering time but that susceptibility to *A. rubi* is under independent genetic control.

Conclusions

A list of Curculionoidea species found on cultivated strawberry in Latvia has been made according to previous publications, and the collections of the authors (1997-2001).

Altogether 16 weevil species (Curculionidae, Apionidae, Attelabidae): *A. rubi, C. floralis, Ch. viridis, Hypera* sp., *N. virens, O. ligustici*, *O. ovatus, P. germanicus*., *Ph. argentatus*, *Ph. maculicornis*, *Ph. pomaceus*, *Ph. plagiatus*, *Rh. bruchoides*, *S. lineatus*, *C. erythropterus* and *T. picirostris,* were registered on strawberry in Latvia.

The twelve weevil species are found during investigation period 1997-2004. The nine species from are these registered for the first time on strawberries in Latvia: *C. floralis, Ch. viridis*, *Hypera* sp., *N. virens*, *Ph. maculicornis*, *Rh. bruchoides*, *S. lineatus*, *C. erythropterus, T. picirostris*.

The eight species: *A. rubi*, *Ch. viridis, P. germanicus*, *Ph. argentatus*, *Ph. pomaceus*, *Ph. plagiatus*, *O. ligustici*, *O. ovatus*, has been noted on strawberry growing areas as strawberry pests caused damage yearly or single year.

The eight species: *C. floralis, Hypera* sp., *N. virens, Rh. bruchoides, S. lineatus*, *C. erythropterus, T. picirostris,* and *N. virens* are not trophically connected with strawberry, these are as occasional species on the strawberry cenosis.

The results of the *A. rubi* injury level evaluation show that the number damaged flower buds on the 1st year (in 2001) and 2nd year strawberry field (in 2002) fluctuated between 0 and 11% depending on cultivar. On the 3rd year strawberry field (in 1999) the average percentage of damaged flower buds was 17%.

Strawberry cultivars show significantly different damage level to strawberry blossom weevil. High resistance to strawberry blossom weevil has cultivar Senga Sengana. Rather high resistance has also cultivars Polka, Marmolada, Syriusz and Rhapsody. The most susceptible among tested cultivars are Bargerglow, Melody, Lihamma and Lvovskaya Rannaya.

The susceptibility of strawberry cultivars to *A. rubi* is not depending only on flowering time but can be controlled genetically.

Acknowledgements

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THE EFFECT OF DEFOLIATION CAUSED BY INFESTATION WITH FIR BUDWORMS (*LEPIDOPTERA, TORTRICIDAE*) ON THE RADIAL INCREMENT OF SILVER FIR (*ABIES ALBA* MILL.) IN SELECTED STANDS IN THE ŚWIĘTOKRZYSKIE MOUNTAINS (POLAND)

Rafał Podlaski, Dariusz Wojdan

Podlaski R., Wojdan D. 2005. The effect of defoliation caused by infestation with fir budworms (*Lepidoptera, Tortricidae*) on the radial increment of silver fir (*Abies alba* Mill.) in selected stands in the Świętokrzyskie Mountains (Poland). *Acta Biol. Univ. Daugavpil., 5 (1): 35 - 39.*

In the Świętokrzyskie Mountains there were carried out studies to determine losses of the radial increment of silver fir (*Abies alba* Mill.) in the areas attacked by fir budworms (*Lepidoptera, Tortricidae*). In the areas where protective measures were used (plots PI and PII) the inhibition of the radial increment lasted shorter (up to 7 years) and potential losses of the radial increment were smaller (up to –29.7%) than in stand KI in which fir budworms were not controlled (inhibition of the radial increment lasted for 13 years, potential loss of the radial increment reached –44.5%).

Key words: *Choristoneura murinana, Epinotia nigricana, Zeiraphera rufimitrana*, defoliation, radial increment

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Introduction

Fir budworms (*Choristoneura murinana* Hb, *Epinotia nigricana* H.S. and *Zeiraphera rufimitrana* H.S.) are the recurrent defoliators of silver fir (*Abies alba* Mill.) in the Świętokrzyskie Mountains. The earliest documented infestation in the Świętokrzyskie Mountains occurred in 1888 (Wiąckowski 1984).

In the years 1970–1980 the forests of the Świętokrzyskie Mountains were affected by the outbreaks of *Ch. murinana* and, to much lesser extent (ca 20% of fir budworms population), *E. nigricana.* and *Z. rufimitrana* (Wiąckowski 1984). In the threatened stands protective measures were applied. Among the preparations used Nexagen and Gamametox appeared to be the most effective (Wiąckowski 1984).

The objective of this study is to determine losses of radial increment in fir stands infested with the fir budworms and in the areas, where protective measures were undertaken.

Methods

The research was carried out in the Suchedniów Forest District, in the areas infested in 1977 (plots PI and PII where in 1978 Nexagen and Gamametoks were used and the control plot KI) and in the Świętokrzyski National Park, in the stand not infested in 1977 (the control plot KII). The investigated stands, about 80 to 100 years of age, with a tree cover of 50–70%, growing in upland mixed forest habitat.

In each of the study plots (0.5 ha in area) 30 sample fir trees were randomly selected (altogether 120 trees). The selected trees belonged to dominant trees (Kraft class II). The sample fir trees were marked, and their d.b.h. (two crosswise measurements, the first one from the side of the slope), height and length of the crown were measured. In April 1994 two increment cores were taken at b. h. from each sample tree. One core was extracted from the side of the slope, and the other perpendicularly to the first one. Cores were first visually crossdated with reference to prominent pointer or marker years. The cores were measured to the nearest 0.01 mm.

The analysis of variance was used to compare the course of the radial increment of fir trees in investigated stands in particular years. The significance of differences between the averages was estimated using the Tukey T test (Fisz 1980).

The radial increment of all trees in the particular study plots was equalized (except the loss period) using a hiperbole expressed by the equation:

$$Z_d = \frac{1}{a + b\,(r - 1913)} \qquad (1)$$

where Z_d — equalized value of the annual ring width in year r, a and b — coefficients of equation.

Then there were calculated (Alfaro et al. 1982, Rieger et al. 1987):

a) global coefficient of the radial increment I:

$$I = \frac{Z_d \text{ actual during the damage period since 1977}}{Z_d \text{ extrapolated during the damage period since 1977}} \qquad (2)$$

b) potential loss of the radial increment S:

$$S = \left(\frac{\text{I of stand analysed}}{\text{I of stand KII}} - 1 \right) 100\% \qquad (3)$$

Results and discussion

Using the analysis of variance the authors verified hypothesis H_0 that the average radial increment for the investigated stands were equal in the particular years. The results are as follows (Fig. 1):

a) years 1914–1976 and 1990–1993: $F < F_{0.01}$ — there is no reason for rejecting the hypothesis H_0 that the average radial increment are equal in the investigated stands;

b) years 1977–1989: $F > F_{0.01}$ — the hypothesis H_0 can be rejected; the average radial increment for particular stands are significantly different from each other.

To distinguish the homogeneous groups of averages (for the data from years 1977-1989) the Tukeys T test at significance level of $\alpha = 0.01$ was used (Tab. 1). After the infestation the radial increment of fir trees significantly decreased (as compared with not infested stand KII) in plot PI in the years 1977–1981, in plot PII in 1977–1983 and in plot KI in 1977–1989 (Tab. 1).

During the loss period stands in the areas infested (PI, PII, KI) show potential loss amounting to –44.5% (Tab. 2).

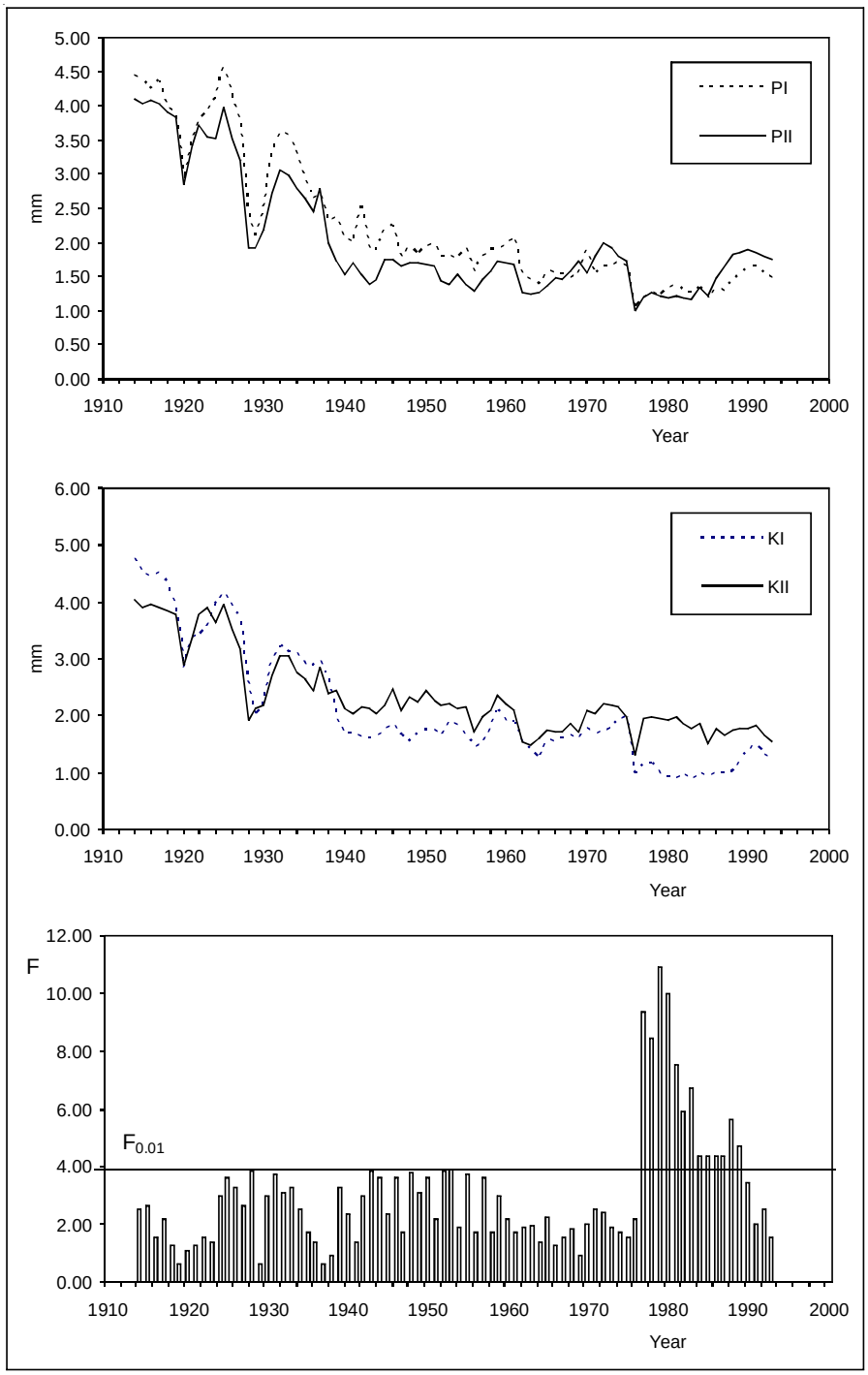

Figure 1. Annual ring width of fir trees (the mean annual increment of 30 fir trees in each of the study plots) of investigated stands (PI, PII, KI, KII) together with calculated and critical ($\alpha = 0.01$) values of F statistics

In plots PI and PII where protective measures were applied the inhibition of the radial increment lasted shorter (5 and 7 years, respectively) and potential losses of increment were smaller (–29.7% and –28.6%, respectively) than in stand KI where fir budworms were not struggled against (there the inhibition of increment lasted for at least 13 years, and potential increment loss was –44.5%) (Tabs. 1 and 2).

The outbreaks of other insects cause still greater losses in the radial increment, eg. *Lymantria monacha* L. may reduce the increment of spruce stands even by –70% as compared with not infested stands (Vinð, Ðvestka 1973).

Conclusions

1. Stands in the areas attacked by fir budworms show a clearly smaller radial increment in comparision with the stand not infested.

2. In the areas where protective measures were implemented the break down of radial increment lasted shorter and potential losses were smaller as compared with the stand where fir budworms were not controlled.

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Table 1. Comparison of the average radial increment in years 1977–1989 for investigated stands by the Tukey T test (plots PI, PII, KI, KII were arranged from left to right according to the increasing values of the average radial increment)

Years	Homogeneous groups α = 0.01			
1977-1981	KI	PI	PII	KII
1982-1983	KI	PII	PI	KII
1984-1987	KI	PII	PI	KII
1988-1989	KI	PI	KII	PII

Table 2. Global coefficients of the radial increment (I) and potential losses of the radial increment (S) in investigated stands

Index	Plots			
	PII	PII	KI	KII
I	0.915	0.930	0.723	1.302
S (%)	-29.7	-28.6	-44.5	0.0

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VERTICAL RANGES OF AMPHIBIANS (*AMPHIBIA*) IN THE ŚWIĘTOKRZYSKI NATIONAL PARK (CENTRAL POLAND)

Dariusz Wojdan

Wojdan D. 2005. Vertical ranges of amphibians (Amphibia) in the Świętokrzyski National Park (Central Poland). *Acta Biol. Univ. Daugavpil. 5 (1): 41 - 45.*

During the research carried out in the years 2002-2004 14 amphibian species were found. Most of them significantly differed between each other with their vertical ranges. Species that occur in terrestrial habitats had broader vertical ranges than species connected with water bodies and their vicinities. It is characteristic that for terrestrial species their mating ranges were often evidently narrower than the total range. Some amphibians occurred in the whole area of the national park but they moved down for the breeding season to water bodies located in foothills of the highest mountain range – the Łysogóry Mountains. The reason for that was the acidification of high springs (the water reaction pH was 4,1-5,3). As the Świętokrzyskie Mountains are rather low, the highest part of them was in the range of a typical mountainous species - *Triturus alpestris* Laur., and also of the lowland species - *Triturus cristatus* Laur., *Triturus vulgaris* L., *Bufo bufo* L., *Rana temporaria* L.

Key words: amphibians, vertical ranges, Świętokrzyski National Park

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Introduction

Vertical ranges of amphibians have been a subject of interest of herpetologists for many years. Especially of those, who carried out their research in mountainous areas. The Świętokrzyski National Park, located in the central part of Poland, can be included to such areas.

The Świętokrzyskie Mountains are one of the oldest in Europe. They were moved up during the Palaeozoic orogeneses and are the only mountains in Central Poland. The mountains are isolated from the other ones and are their characteristic features are: low altitude and specific habitat conditions (geology, geomorphology, soils, climate, plant cover etc.). Especially interesting is the fact that the fauna and flora are represented by lowland and mountain species. However, species typical for uplands and mountains dominate here. The additional value of this region is the occurrence of endemic and relict plants (mostly post-glacial). A high differentiation of the surface relief results in variability of habitats. The most valuable and highest parts of the Świętokrzyskie Mountains are protected within the Świętokrzyski National Park.

The research was carried out in the years 2002-2004 in the area of the Świętokrzyski National

Park (7.626,45 ha) and in its protective zone (20.786,07 ha). The altitude is very variable and stretches between 230 and 612 m asl.

The aim of this research was to investigate vertical ranges and population numbers of different amphibian species. During the research the biology and ecology of different species were taken into account, including habitat preferences.

Materials and methods

The observations of amphibians were carried out in water bodies (mostly during the mating season) and in terrestrial habitats with particular regards to spring and autumn migrations. Terrestrial and water wintering habitats of amphibians were periodically checked, too. The observations were carried out in various water bodies (usually small ones), including overflows, beaver ponds, pools, springs, ditches and large puddles after rainfalls. Most of these water bodies had a periodic character. Brooks and streams were checked, too. Especially in those places where some overflows were found (e.g. near sluices) or where the current was slow. All water bodies were checked within the national park and most important within the protective zone around the park. The numerical data was obtained by the method of complete catches. It is more objective method than the Lincoln˙s test (Inger i Greenberg 1966, Trojan 1980). The latter one can be used only in relation to numerous species.

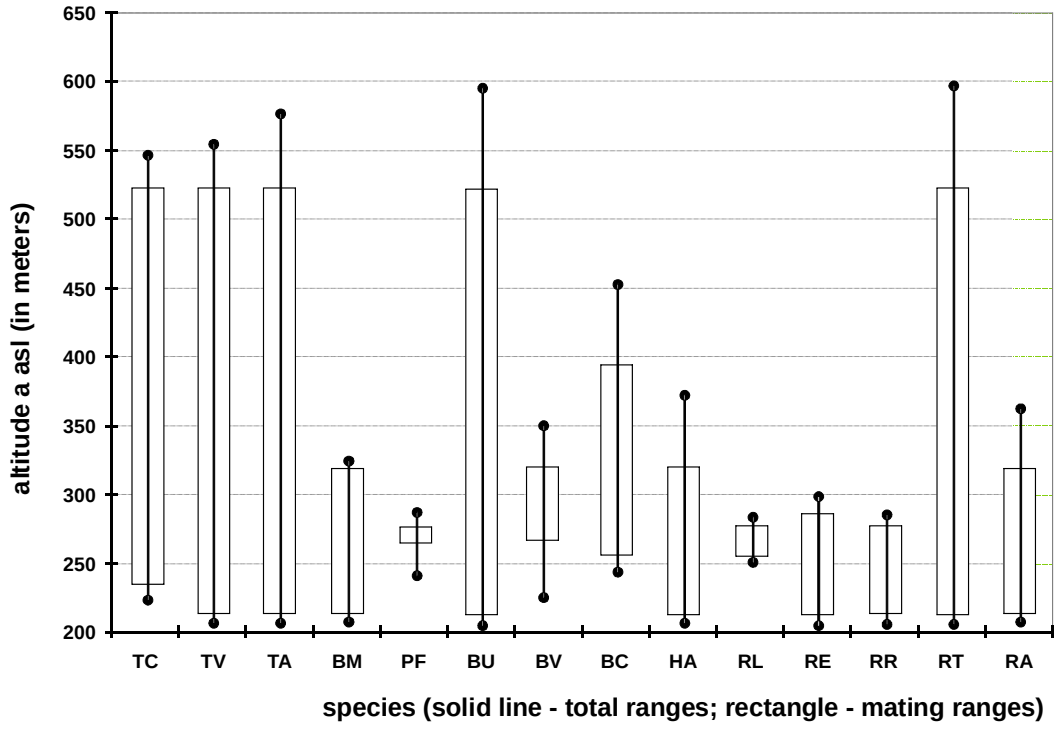

Fig. 1. Vertical ranges of amphibians (*Amphibia*) in the ? wi¿ tokrzyski National Park and its protective zone (TC - *Triturus cristatus,* TV - *T. vulgaris,* TA - *T. alpestris,* BM - *Bombina bombina,* PF - *Pelobates fuscus,* BU - *Bufo bufo,* BV - *B. viridis,* BC - *B. calamita,* HA - *Hyla arborea,* RL - *Rana lessonae,* RE - *R. esculenta,* RR - *R. ridibunda,* RT - *R. temporaria,* RA - *R. arvalis*).

The research was carried out in the years 2002-2004. In the fist research period the horizontal and vertical ranges of amphibians were investigated. The research included mating areas as well as migration corridors in spring (to mating sites) and in autumn (to wintering sites). In 2004 the number of amphibians was checked in mating sites. Additionally, the water reaction (pH) was measured in the investigated water bodies. Potential threats to amphibians and conservation measures were described, too.

Results

In the Świętokrzyski National Park 14 amphibian species were found: three urodelans (all from the family *Salamandridae* and the genus *Triturus*) and 11 anurans. The representatives of following families were found here: *Discoglossidae* (1 species of the genus *Bombina*), *Pelobatidae* (1 species of the genus *Pelobates*), *Bufonidae* (3 species of the genus *Bufo*), *Hylidae* (1 species of the genus *Hyla*) i *Ranidae* (5 species of the genus *Rana*).

The amphibian populations had the following vertical ranges (in brakets – the ranges of mating sites): crested newt *Triturus cristatus* Laur. – 250-550 (260-530) m asl, smooth newt *Triturus vulgaris* L. – 230-560 (240-530) m asl, alpine newt *Triturus alpestris* Laur. – 230-580 (240-530) m asl, fire bellied toad *Bombina bombina* L. – 230-345 (240-340) m asl, common spade foot *Pelobates fuscus* Laur. – 260-310 (290-300) m asl, common European toad *Bufo bufo* L. – 230-600 (240-530) m asl, green toad *B. viridis* Laur. – 250-370 (290-340) m asl, natterjack *B. calamita* Laur. – 260-465 (280-410) m asl, European tree frog *Hyla arborea* L. – 230-390 (240-340) m asl, pond frog *Rana lessonae* Cam. – 270-310 (280-300) m asl, edible frog *R. esculenta* L. – 230-320 (240-310) m asl,

Table 1. Vertical ranges of amphibians *(Amphibia)* in the ? wi¿ tokrzyski National Park and its protective zone

Species	Vertical ranges (m asl)	Vertical ranges of mating sites (m asl)	No of mating sites	No of mating individuals	% individuals
Triturus cristatus Laur.	250-550	260-530	6	79	4.1
Triturus vulgaris L.	230-560	240-530	22	370	19.1
Triturus alpestris Laur.	230-580	240-530	25	630	32.5
Bombina bombina L.	230-345	240-340	4	11	0.6
Pelobates fuscus Laur.	260-310	290-300	2	5	0.3
Bufo bufo L.	230-600	240-530	14	125	6.5
Bufo viridis Laur.	250-370	290-340	5	30	1.6
Bufo calamita Laur.	260-465	280-410	2	4	0.2
Hyla arborea L.	230-390	240-340	5	18	0.9
Rana lessonae Cam.	270-310	280-300	3	9	0.5
Rana esculenta L.	230-320	240-310	9	92	4.8
Rana ridibunda Pall.	230-410	240-400	3	7	0.4
Rana temporaria L.	230-600	240-530	24	444	22.9
Rana arvalis Nilss.	230-460	240-310	8	112	5.8
Total	230-600	240-530	25	1936	100

marsh frog *R. ridibunda* Pall. – 230-410 (240-400) m asl, common frog *R. temporaria* L. – 230-600 (240-530) m asl, field frog *R. arvalis* Nilss. – 230-460 (240-310) m asl (Fig. 1, Table 1).

The water bodies inhabited by amphibians in the mating season are predominantly periodic bodies. The amphibians were not present in acidic springs in the area of the Łysogóry Mountains (the highest mountain range of the Świętokrzyski National Park). The water reaction (pH) in this area was 4,1-5,3. In the terrestrial habitats the amphibians were found in forests, open habitats (meadows, fields). However, evident habitat preferences were observed between different species. The species connected with waters were observed in water bodies and their vicinities (*Bombina bombina, Rana lessonae, R. esculenta, R. ridibunda*).

Discussion

The comparison of the obtained results with findings of other authors (Ņepeķņåā, ×åšķīā 1949, Frommhold 1959, Mertens 1964, Arnold, Burton 1978, Juszczyk 1987) shows that the amphibians in the Świętokrzyski National Park reach lower altitudes that in other parts of Europe. It is a result of a relatively low altitude of the research area (up to 612 m asl) and the acidic reaction of most mountain springs (Szczęsny 1990, Wojdan 1997). The vertical ranges of amphibians are also results of lack of larger water bodies in higher altitudes and severe cold climate in this area.

The authors who earlier carried out the research in the Świętokrzyski National Park have not dealt with the problem of vertical ranges (Ćmak i Zbożeń 1985, Kowalewski 1985). Only in one work the data on the vertical ranges of amphibians were presented in relation to a part of the Świętokrzyski National Park (Ichniowska-Korpula 1994). However, this paper dealt only with total ranges without taking into account mating ranges of amphibians. The data from the mentioned publication show clear similarities, but also some differences. It may result from the fact that the vertical ranges, similarly to the horizontal ones, are not permanent and can change under different factors. The obtained results revealed that the vertical range of *Bufo calamita* increased, whereas the ranges of *Rana esculenta* decreased.

The results of the research confirm also earlier findings of Ichniowska-Korpula (1994) that in higher altitudes a typical mountain species - *Triturus alpestris* can be found along with typical lowland species (*Triturus cristatus, T. vulgaris, Bufo bufo* and *Rana temporaria).* The other amphibians were found in sites located at lower altitudes.

Conclusions

The vertical ranges of amphibians in the Świętokrzyski National Park are different that those given for other mountains in Europe. Some of the species were not found at higher altitudes, despite the fact that the Świętokrzyskie Mountains are one of the lowest in the world. The total ranges are significantly larger than the mating ranges. It relates especially to the terrestrial species. It is also characteristic that the vertical ranges are not permanent and they change. The ranges can change even within very short time ranges - 10-12 year.

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INFLUENCE OF PLACE OF RESIDENCE AND POSSIBLE PROPERTY LOSS ON LARGE CARNIVORE ACCEPTANCE IN ESTONIA AND LITHUANIA

Linas Balčiauskas, Tiit Randveer, Henrikas Volodka

Balčiauskas L., Randveer T., Volodka H. 2005. Influence of place of residence and possible propertyloss on large carnivore acceptance in Estonia and Lithuania. *Acta Biol. Univ. Daugavpil., 5 (1): 47 - 53.*

In the paper it is shown that place of residence of a respondent and possible loss of money due to carnivore-made damages is among factors determining the acceptance of large carnivore by humans. Having compared Lithuanian and Estonian respondents with respect to place of their residence – city, town, village, rural area – we found that rural inhabitants may become a crucial group of public not accepting carnivore conservation. In both countries, too many respondents refused to have large carnivores not merely close to their residence, but at a reasonable distance. Lower acceptance was shown by persons who expected significant economic loss due to carnivore-made damage. A number of respondents who expect such losses of money is bigger in Lithuania.

Key words: large carnivores, human dimensions, damage, species acceptance, place of residence

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Introduction

The large carnivores, wolves, bears and lynx, are species that attract a great deal of interest wherever they occur. Many people view them as being beautiful animals while others regard them a source of conflict. In Norway, for example, the return of these species to the countryside during the last 10 years after several decades of absence has generated a lot of conflicts with hunters, farmers and rural people, although the general public are favourable to their presence (Linnell et al. 2003). A similar picture has appeared in other western European countries like France and Switzerland. The result is a very complicated social picture, which makes the management and conservation of carnivores difficult.

Investigations of human dimensions of large carnivores have started in North America, but now

this method is exploited in many countries of Europe, too. It was shown that acceptance of large carnivores was related to changes in human behaviour and emotions. It was shown that positive perception of carnivores may be related to the positive attitude to nature in general (Kaltenborn, Bjerke 2002). Also, it is possible that negative perception of large carnivores may be associated with the damage they cause. Most of these regularities can be found in the countries where large carnivores were introduced or their populations re-established after a long period of time. In the Baltic countries wolves or lynx have never been extinct; moreover conflicts with cattle owners and hunters are interfering with conservation programmes.

The aim of this paper is to compare the two Baltic countries that differ in the composition of large carnivore species (there is no permanent bear population in Lithuania and the number of lynx is much smaller), their numbers of and in large carnivore acceptance.

Material and methods

The questioning of respondents in both countries was done in a similar way. One class per school was chosen randomly (two classes in very small rural schools) and questionnaires distributed to each pupil, excluding brothers/sisters if they attended the same class. Pupils were asked to bring questionnaires home to be filled in by a member of the family living in the same house, whose birthday was on the nearest date. That could be either a pupil, or parent, sibling, grandparent etc. The only condition was the respondent˙s age - at least 15 at the time of filling in the questionnaire.

Before questioning, permission from the director of the school was asked. We used three methods of the questionnaire spread – the personal method where an investigator itself was coming to the school and to the class; the mediator method where a teacher/director was coming to the class together with the investigator; and the impersonal method where a teacher was contacted by phone first and then questionnaires sent to him/her by post. In all cases teachers were informed about the aim of questioning, situation of large carnivores in the country and instructed to collect questionnaires in a week or similar time.

We processed 1541 answers from Lithuania and 860 answers from Estonia. In Lithuania, main regions were capital city Vilnius, north-west (region with highest wolf damage), north, south east and central part of the country, but part of questionnaires were spread across the country. In Estonia, data were collected in Tallinn city, northern part (Harjumaa), eastern part (Jõgevamaa) and southern part (Võrumaa), of the country, as well as Lääne-Virumaa county – region, where the wolves are aggressive.

The data were computerised in MS ACCESS database and processed using standard queries. For the comparison between countries, we used a share of various categories (in percent from all sample). The statistical significance of the distribution of respondents within groups was evaluated using the χ^2 method in comparing theoretical and empirical distributions of answers (Ludwig & Reynolds 1988) and drawing 2 x 2 tables (Fleiss 1989). The data were processed using the software package Statistica version 6.0 (StatSoft 2004). The null hypothesis involved was that respondents from cities were in general more positive to large carnivores, and the assumption behind this is that rural people are more involved in the carnivore damage conflict.

Results

In the sample from Estonia, men were the dominating sex – 63.2% (women – 36.8%), whereas in Lithuania vice versa (35.1% men and 64.9% women). The place of residence of respondents was also different, reflecting concentration of agriculture in the country (Table 1) and historical development – in the soviet times farmsteads in Lithuania were moved to kolchoz-type settlements. This difference is statistically reliable (χ^2 =611.9, $p<0.001$)

Table 1. Type of residence among respondents from Lithuania and Estonia

	Lithuania		Estonia	
	n	%	n	%
Rural residents – farmstead	113	7.4	275	32.2
Villages (<3000 inhabitants)	612	40.2	189	22.1
Small towns (3–40 thousand inhabitants)	342	22.5	226	26.4
Big towns (>40 thousand inhabitants)	454	29.9	165	19.3

The next step was the analysis of answers to the question whether respondents would lose any income due to the presence of large carnivore in the area. The answers show that more Lithuanian respondents are certain about the loss of income (Table 2). Distribution of answers between countries differs significantly (χ^2 =106.4, p<0.001)

And finally, we investigated how close to the place of their residence our respondents would like to let large carnivores to exist. Three species – wolf, bear and lynx – were analyzed separately. The biggest and statistically significant differences in the species acceptance between countries were found in bears: less Lithuanian respondents would like to see bears at a distance less than 1 km from the place of residence (1.5% vs 3.4% in Estonia), at a 1–5 km distance (4.3% vs 11.8%), and at a 6–10 km distance (8.1% vs 16.8%), but more of them would not like to have bears in the district (47.3% vs 26.7% in Estonia). The same picture of species non-acceptance was found with lynx – Estonians were more tolerant to close presence of lynxes near their place of residence. Differences about the acceptance of wolves were less expressed: 3.6% Lithuanian and 4.3% Estonian respondents could accept wolves at a distance less than 1 km from their residence, 10.7% and 13.3%, respectively, - at the distance of 1 - 5 km, 14.3% and 17.9%, respectively, at the distance of 6 - 10 km, but such differences still were highly reliable (χ^2 =132.5, p<0.001). Distribution of answers is shown in Fig. 1.

Discussion

Most current species and habitat declines are largely a result of socioeconomic and political forces. On this basis, some authors have argued that human preferences and values should also be taken into account in devising appropriate and effective conservation measures (Norton 1986). This has increased emphasis on expressing the conservation benefits of particular species or habitats in economic terms. Many foreign examples show that species conservation readiness in mammals can be measured by willingness-to-pay method (see White et al. 2001).

In our previous investigation of HD in Lithuania (Balčiauskas 2001, Balčiauskas, Volodka 2001), it was also tested whether respondents could invest their money in repairing damage done by

Table 2. Answers to the question: "Would the presence of large carnivores in your area directly cause you to lose money?"

	Lithuania		Estonia	
	n	%	n	%
Do not know	477	31.8	210	24.5
No	671	44.8	497	57.9
Yes, a bit	256	17.1	110	12.8
Yes, a lot	95	6.3	41	4.8

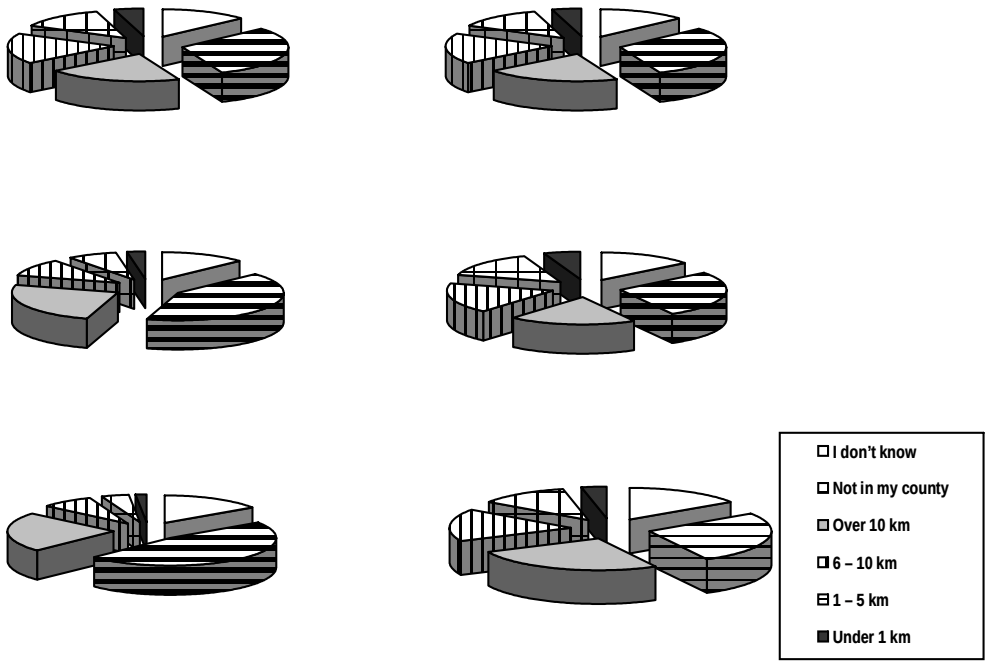

Fig. 1. Distribution of answers to the question "At what distance from the place you live can you accept the occurrence of large carnivores?" (Top row – wolf, middle row – lynx, bottom row – bear; left column – Lithuania, right column – Estonia)

wolves. From the huge questionnaire, we have chosen just two questions: (1) would you give money to the foundation to repair wolf damage, and (2) - can you award money as a fee for a hunted wolf? Difference between answers of respondents living in towns and cities and rural areas was statistically reliable (χ^2 =17.9, $p<0.01$ for the first question and χ^2 =228.2, $p<0.001$ for the second). More rural respondents were wiling to pay for a wolf's head (15.3% vs. 7.7% for town dwellers) as well as to repair damage caused by wolves (34.8% vs. 33.3%). It is clear that close contacts with the wild make rural inhabitants less tolerant to their existence.

One of the major problems in such evaluation is that people tend to overestimate their willingness to pay unless they are faced with the situation of real money-giving-away. Loomis et al. (1996) found that hypothetical willingness-to-pay was two times larger than real willingness-to-pay, and Neill et al. (1994) found it to be approximately nine times larger. It was shown also that willingness-to-pay is greater for marine mammals than terrestrial ones, and recreational users of species (tourists or hunters) are generally more willing than residents to pay towards species conservation. It is likely to reflect many interrelated factors such as ethical and moral values, knowledge and tradition, and monetary values may not be an adequate representation of these broader considerations. Willingness-to-pay approaches should therefore be used in addition to, rather than in place of, expert judgements and more deliberative approaches towards policy decision-making for conservation (White et al. 2001).

Thus, we first decided to analyse whether a *possibility* to loose income due to wolf damage, which might only be expected for rural inhabitants, – may influence carnivore acceptance by respondents. Later, we expect to measure acceptance against real estimations of the carnivore-made damage. Crostabulating respondent˙s expectance of monetary loss and wolf acceptance in different distance from the place of residence gave the result presented in Table 3. The first assessment of wolf damage in Lithuania has already been done (Balčiauskas et al. 2002) and it shows that property loss for rural dwellers is not a possibility, but a *real threat* in some regions of Lithuania.

We found that in general persons who *expected* great loss of income, showed less acceptance to wolves. The numbers of those who should not let wolves to their district were significantly higher in a group expecting great loss of money in Lithuania (χ^2 =65.9, p<0.001) as well as in Estonia (χ^2 =161.7, p<0.001). Table 1 shows that respondents who doubt about their income loss can be most tolerant. The same regularities have been expressed for lynx and bear, so we will not cover this in detail.

A bit unexpected may be the fact that so many respondents agree to have wolves very close to settlements – even those who expect great property losses. This can be explained by confidence in the widespread belief that wolves do not kill cattle near dens.

Table 3. Wolf acceptance with regard of expected monetary loss

Monetary loss	Acceptable distance	Lithuania		Estonia	
		N	%	n	%
Questionable	Uncertain	43	9.0	28	13.4
	Not in the district	208	43.7	96	46.1
	> 10 km	122	25.7	41	19.6
	6-10 km	50	10.5	30	14.4
	1-5 km	42	8.8	11	5.1
	< 1 km	11	2.3	3	1.4
	Total	476		208	
None	Uncertain	56	8.4	73	14.7
	Not in the district	212	31.8	105	21.2
	> 10 km	178	26.7	107	21.6
	6-10 km	119	17.8	98	19.8
	1-5 km	83	12.4	88	17.7
	< 1 km	19	2.9	25	5.0
	Total	667		496	
Small	Uncertain	13	5.0	12	10.9
	Not in the district	76	29.7	35	31.8
	> 10 km	89	34.8	23	20.9
	6-10 km	39	15.2	25	22.7
	1-5 km	25	9.8	10	9.1
	< 1 km	14	5.5	5	4.6
	Total	256		110	
Big	Uncertain	2	2.2	2	4.9
	Not in the district	45	48.4	25	60.9
	> 10 km	24	25.8	6	14.6
	6-10 km	7	7.5	0	0
	1-5 km	8	8.6	4	9.8
	< 1 km	7	7.5	4	9.8
	Total	93		41	

These general regularities are not surprising, however – explanation was given in other countries, studying mammal conservation problems through willingness-to-pay models. Residents were always willing to pay less than visitors (Loomis, White 1996). Visitors were eager to pay between 70 and 118 US dollars for the reintroduction of wolves in Yellowstone, USA (Duffield 1992), while residents of the area merely 16 to 21 US dollar (US Department of the Interior 1992). Investigators also found that willingness-to-pay was positively related with the proposed size of change in the population. These authors argued that willingness-

to-pay results were therefore not merely symbolic but sensitive to the magnitude of changes proposed (White et al. 2001).

In both countries, Lithuania and Estonia, after the wolf number boom in mid-1990, currently the numbers of animals have stabilised or are going down, but we have no evidence that this fact is well known to the wider public, or, moreover, can influence acceptance of the species. Thus, our finding is (or may be) based on the acquisitive mentality and ownership. Wildlife is owned by no one, but exploitation or use of the resource is influenced by the property rights of the land where it is found. In situations of large carnivore conservation, landowners and farmers may have considerable influence on the species management and conservation. It is preferable either to consider the views of different sectors of society explicitly (Bright & Halliwell 1999) or at least to include the relevant information as a potential factor affecting willingness-to-pay (White et al. 2001).

Also it is quite clear (see Fig. 1), that species of carnivores, which are not common to respondents (such as lynx or bear in Lithuania), are not well-accepted. This is based on psychology of accepting, and was shown in many other countries, including Norway (Kleiven et al. 2004).

Conclusions

The analysis of large carnivore acceptance depending on the place of residence (city, rural area) and expected loss of money due to carnivore damage in Lithuania and Estonia shows that

1. Worst acceptance was shown to large carnivore species, which are uncomon in the country / unknown by respondents and by rural respondents.

2. Too many respondents refuse to have large carnivores not merely close to the place of their residence, but at reasonable distances in general, including even the district.

3. Lower acceptance is shown by persons who expect significant loss of their money/property due to carnivore-made damage.

4. By comparing two countries we found that the number of respondents who expect such losses of money is bigger in Lithuania.

5. Rural inhabitants may become a crucial group of the public not accepting carnivore conservation.

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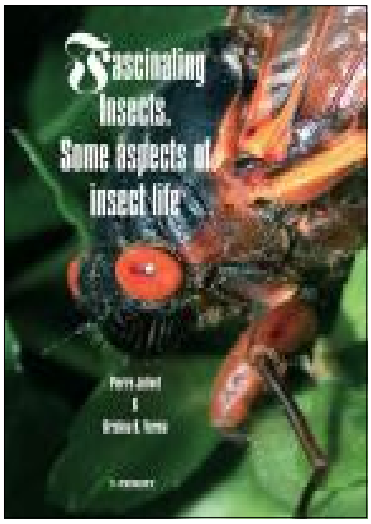
Fascinating Insects. Some aspects of insect life

Pierre Jolivet & Krishna K. Verma



ISBN 954-642-242-8, 165x240, richly illustrated by b/w and
color photos, graphs and drawings, indexes.
In English, hardback, 320 pp.
Publication date: November, 2005.
Price: EURO 34.95.

This book on the very successful and much diversified group of organisms, the insects, deals with some interesting aspects of insect life, which are often ignored in Entomology text-books, such as ants making “slaves”, insect migrations, chemical defence strategies in insects, parental care, ants-plants relationship etc.. It also includes first hand experiences with insects of the great traveller-naturalist Prof. P. Jolivet, who narrates the emergence in large numbers of the seventeen year cicada in USA in May 2004 after 17 years of underground life, occurrence of insects on the great tepuys of Venezuela, marching of army ants in the tropical Africa, beetles carrying a “forest” on their back in New Guinea etc. It is hoped that the book will prove beneficial as a side reading to students of Entomology and Biology. It also has the nature of a popular reading, which provides an insight into the interesting but often untold facets of insect life to the common reader.

Pierre Jolivet, D.Sc. has written many research papers and books on the beetle family Chrysomelidae. His areas of special interest include the biology of Timarcha, food plants of chrysomelids, and ants-plants relationship.

K. K. Verma, M.Sc., Ph.D. taught Zoology and Entomology for over 35 years, both at undergraduate and postgraduate levels in M. P. Government Colleges, India. He has worked for a long time in the field of the functional morphology and physiology of Chrysomelidae. He has to his credit a number of outstanding papers published in both Indian and international journals.

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DIVERSITY OF MAMMALS IN VILNIUS CITY

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Balčiauskas L., Mažeikytė R., Baranauskas K. 2005. Diversity of mammals in Vilnius City. *Acta Biol. Univ.Daugavpil., 5 (1): 55 - 66.*

The diversity of mammal fauna in the urbanized zone and outskirts of Vilnius city is analyzed, comparing it with other cities. In 1982–2004, 51 species of mammals were registered in Vilnius: 5 species of *Insectivora*, 11 of *Chiroptera*, 18 of *Rodentia*, 2 of *Lagomorpha*, 11 of *Carnivora* and four species of *Artiodactyla*. 29 mammal species (57% of the total) were registered in the urbanized part of Vilnius. Synantropic species (house mouse and brown rat), eastern hedgehog, European mole, common shrew, bank vole, common vole and red fox are mammals inhabiting the urbanized part of most cities. Other species, such as harvest mouse, water vole, yellow-necked mouse, muskrat, striped field mouse, sibling vole, pine marten, beech marten, roe deer and wild boar, are well established in the outskirts. Quite synantropic are many bat species, but some of them were registered in the urbanized parts of the cities in hibernacula only. The pond bat, Brandt˙s bat, barbastelle, brown long-eared bat, noctule, Leisler˙s bat, serotine bat, northern bat, particoloured bat, northern birch mouse, mountain hare, stoat, brown bear and otter – 14 species in total – are included into the Red Data Book of Lithuania.

Key words: Vilnius, Lithuania, mammals, diversity, protection

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Introduction

The diversity of city fauna has always interested theriologists as well as nature protection bodies – it gives insight into environmental conditions, presence of certain species, etc. In the last years Lithuanian public was intrigued by the visits of the brown bear to the Vilnius city environs in 2003, two lynxes caught in the middle of Panevėžys town in 2004, and a moose caused vehicle collision with human death in Klaipėda town in 2005. In earlier decades, moose should also visit the very center of Vilnius city.

Patches of natural and semi-natural vegetation (meadows, parks, forests and collective gardens) and water bodies are the main dwelling sites of many mammal species in the city, though several species exhibit strong sinantropic tendencies by choosing to live quite close to humans. For some species of bats, rodents and carnivores, the city environment is not merely a desired, but an essential habitat.

Data on the diversity of Vilnius mammal fauna is presented in the "Atlas of Lithuanian mammals, amphibians and reptiles" (Balčiauskas et al. 1997, 1999). Species composition of mammals in Vilnius city is presented in several publications. Quite well investigated are bats (Pauža, Paužienė 1996, Starodubaitė 1999, Masing et al. 1997, Laurukėnienė 2001, Baranauskas 2001, 2003, 2004,

Baranauskas et al. 2005) and small mammals – insectivores and rodents (Mažeikytė et al. 1999, Morkvėnas 1999, Starodubaitė 1999, Čivilytė 2002, Tamošiūnaitė 2002, Baranauskas et al. 2003). There are published data on the otter (Baranauskas, Mickevičius 1993, 1995, Baranauskas et al. 1994) and weasel (Baranauskas, Ðmigelskas 2001). There is also some information on mammals in Kaunas and Ðiauliai towns in Lithuania (Kauno... 2005, Budrys 2005). Comparative investigations on the diversity of mammals in cities were done in Moscow (Tikhonova et al. 2004), Riga (Zorenko, Leontyeva 2003), Kyiv (Zagorodniuk 2003) and Brno (Pelikan et al. 1983).

The aim of this paper is to present data on mammal diversity in Vilnius city, both urbanized and suburb zones, and to compare our data with that published by other authors.

Material and methods

The city of Vilnius is situated in the east of Lithuania, around the confluence of the Neris and Vilnia rivers. The territory of the city is prolonged in the south-north direction (ca. 20 km); in the east-west direction it extends ca. 10 km (fig. 1). The territory of Vilnius city covers several forest patches, mainly pine stands, and city parks. In the eastern part of Vilnius there are parks of Pavilnis, Žaliakalnis, Viktoriškės, Kalnų and Ðveicarija. In the northern part, Verkiai forest and Verkiai Park, as well as Jamontas Park are situated. In the southern part there are Paneriai and Bukčiai forests and Burbiškės Park. In the central part of Vilnius there is ca. 160 ha area Vingis Park (old pine stand). On the perimeter of the city several collective farming territories are situated.

The main water bodies in the city are Balsys Lake (54 ha), Gulbinas (37 ha), Maþasis Gulbinas (10 ha) and Antavilys lakes (Kilkus 1986) with more than 10 smaller lakes and ponds. The Neris River is the second biggest river in Lithuania. Several smaller rivers (Vilnia, Vokė and Riešė) and rivulets (Sudervėlė, Cedronas and Turniškė) are flowing through the territory of Vilnius.

City dwelling mammals were investigated in 1992 (Pavilnys) and in 1998–2004 (Žaliųjų Ežerai, Verkiai, Kalvarija, Jeruzalė, Santariškės, Visoriai, Fabijoniškės, Baltupiai, Vyskupiškės, Šeškinė, Barsukynė, Žemieji Paneriai, Pilaitė and Sudervėlė environs, Vingis Park) (Fig. 1). Several methods were employed, including (i) small mammal trapping with snap traps and live traps, (ii) hedgehog and mole registration according their tracks, excrements and molehills, (iii) bat registration with Tranquility II ultrasonic detector and in hibernacula, (iv) the transect method for hares, carnivores and ungulates, and (v) roadkills and visual observations for all species.

Livetrapped rodents and insectivores were released after species identification. In 1998, 2000 and 2001, trapping was performed year-round, while in 1992, 1999 and 2002 in autumn only. Hedgehogs and moles were surveyed in the most suitable habitats: forested areas, meadows, roadsides, etc. In 1999–2004, visual bat observations were done in hibernacula in Ðilas, Pavilnys, Šeškinė, Verkiai and Paneriai tunnel by shortly spotlighting them on the walls and in crevices. All transect surveys of hares, carnivores and ungulates were done in the winter period on snow and in other seasons on damp ground, mainly outside the urbanised city center (Fig. 1).

Other sources of information on the Vilnius mammal fauna include the published data, information provided by foresters and hunters, plus data from irregular investigations done by authors in 1982–1983, 1987, 1994–1995 and 1997.

Results

Five species of insectivores, 11 species of bats, 18 species of rodents, two species of hares, 11 species of carnivores and four species of ungulates were registered in Vilnius city – a total of 51 species of mammals (Table 1). 14 of them are included into the Red data Book of Lithuania (RDB), embracing about 60% of the total threatened mammal list (Lietuvos... 2003). According II Annex of Habitat Directive, the following species found in the city are of European importance:

Fig. 1. Investigation sites in Vilnius city (shaded areas are built up).
Urbanized zone and city parks: 4 – Kalvarijos, 8 – Fabijoniškės, 9 – Baltupiai, 10 – Vingis Park, 12 – Šeškinė;
Suburbs and green zones: 1 – Pavilnys, 2 – Žalieji Ežerai, 3 – Verkiai, 5 – Jeruzalė, 6 – Santariškės, 7 – Visoriai, 11 – Vyskupiškės, 13 – Barsukynė, 14 – Aukštieji and Žemieji Paneriai, 15 – Pilaitė environs, 16 – Sudervėlė.

pond bat, barbastelle, brown bear and otter; the beaver is not included as Lithuania has an exception for this species.

The eastern hedgehog (*Erinaceus concolor*) is common in the forested areas of the city, but not abundant. The species is found in the urbanized zone and city parks (author˙s data, Morkvėnas 1999, Tamošiūnaitė 2002, Bluzma 2004), as well as in the suburbs and green zone (Balčiauskas et al. 1999). Roadkills were registered on all main roads from Vilnius to Kaunas, Trakai, Ukmergė, Molėtai and other smaller roads (author˙s unpublished data)

Table 1. Mammal species registered in Vilnius city and their status (RDB – Red Data Book of Lithuania)

Order	Common species (category of RDB)	Rare species (category of RDB)
Insectivora	*Erinaceus concolor*, *Talpa europaea*, *Sorex minutus*, *Sorex araneus*	*Neomys fodiens*
Chiroptera	*Myotis daubentonii*, *Nyctalus noctula* 4(I)*, *Pipistrellus nathusii*, *Eptesicus serotinus* 4(I)	*Myotis dasycneme* 3(R), *M. brandtii* 4(I), *Plecotus auritus* 4(I), *Barbastella barbastellus* 4(I), *Nyctalus leisleri* 4(I), *Eptesicus nilssonii* 3(R), *Vespertilio murinus* 4(I)
Lagomorpha	*Lepus europaeus*	*Lepus timidus* 4(I)
Rodentia	*Sciurus vulgaris*, *Castor fiber*, *Clethrionomys glareolus*, *Microtus arvalis*, *Micromys minutus*, *Apodemus agrarius*, *A. flavicollis*, *Mus musculus*, *Rattus norvegicus*	*Muscardinus avellanarius*, *Sicista betulina* 4(I), *Arvicola terrestris*, *Microtus agrestis*, *M. oeconomus*, *M. rossiaemeridionalis*, *Apodemus sylvaticus*, *Rattus rattus*, *Ondatra zibethicus*
Carnivora	*Vulpes vulpes*, *Nyctereutes procyonoides*, *Martes martes*, *M. foina*, *Mustela nivalis*, *M. vison*, *M. putorius*, *Lutra lutra* 5(Rs)	*Mustela erminea* 4(I), *Meles meles*, *Ursus arctos* 0(Ex)
Artiodactyla	*Capreolus capreolus*, *Sus scrofa*	*Cervus elaphus*, *Alces alces*

*: 0(Ex) – extinct, 3(R) – rare, 4(I) – indeterminate, 5(Rs) – restored

The European mole (*Talpa europaea*) is very common and registered in all investigated localities, even in the city centre – on the green zone between traffic lines and in roundabouts. Moles are abundant in green zones and farming areas.

The pygmy shrew (*Sorex minutus*) was found in the forested and shrubby areas of Verkiai, Santariškės and Pilaitė environs. It is not abundant – in Verkiai Regional Park its abundance was 4–16 ind. per 100 traps/day (2001), in Pilaitė environs (1999) just 0.57±0.57 ind. per 100 traps/day (Morkvėnas 1999). The common shrew (*Sorex araneus*) is the most abundant and widespread of all city dwelling shrews. It is found in forested areas, parks, meadows, farming areas, shrubs. Its abundance may reach 2–20 ind. per 100 traps/day.

The water shrew (*Neomys fodiens*) is restricted in cities to the following habitats: slow-flowing or standing water bodies with overgrown shores. In Vilnius, these animals were caught near the ponds in Santariškės and Verkiai, in the swampy area of Þalieji Eþerai (see fig. 1). In 1999 near the Sudervėlė rivulet, a single water shrew was caught with the workload of 500 traps/day (Morkvėnas 1999).

The pond bat (*Myotis dasycneme*) was registered in the city in the warm period (Verkiai) as well as in several hibernacula. Pond bats are not abundant in summer, but in Paneriai there is one of the most numerous hibernacula for this species in Lithuania (over 50 individuals). In the period of 2000–2005 the number of wintering animals was growing (Baranauskas et al. 2005). The daubenton˙s bat (*Myotis daubentonii*) is common in Vilnius in summer as well as in hibernacula. The biggest known hibernaculum of this species in Lithuania is located in the Paneriai tunnel – a damp underground accommodation, which is a fortune for the species wintering. Smaller groups of this species were found in other hibernacula of the city – Šeškinė and Paneriai. The Brandt˙s bat (*Myotis brandtii*) was for the first time registered in Vilnius in 2001. In 2004–2005 these bat were wintering in 3 hibernacula.

The brown long-eared bat (*Plecotus auritus*) is not abundant in Vilnius. Animals were registered in summer in Verkiai environs, Jeruzalė forested areas and Vingis Park (see fig. 1). A few animals were found in all known hibernacula.

The Barbastelle (*Barbastella barbastellus*) is common in dry hibernacula of Vilnius city;

groups of up to 60–80 animals were found. Currently, the reduction in numbers of wintering barbastelles occurs in Šeškinė and Šilas hibernacula, while in other hibernacula their numbers are stable. In the period of eight years, the number of wintering barbastelles in Šeškinė reduced from 22 in 1997–1998 to 11 in 2004 and only three specimens in 2005 (Baranauskas et al. 2005).

The noctule (*Nyctalus noctula*) is not abundant in the city, but registered in many places. It is common in Verkiai (Laurukėnienė 2001). One of the biggest breeding colonies of noctules in Lithuania is in Jeruzalė; in 2001 it comprised more than 30 individuals. The Leisler˙s bat (*Nyctalus leisleri)* was registered in Vilnius only once (in 1998) in Kairėnai botanical garden (Starodubaitė 1999).

The Nathusiu˙s pipistrelle (*Pipistrellus nathusii*) is one of the most common bats in the forested areas of Vilnius city. Possibly, they form mixed groups with common pipistrelles (*P. pipistrellus*). These bats do not winter in Lithuania; at the beginning of August they migrate from the territory of our country.

The serotine bat (*Eptesicus serotinus*) is not rare in the city. Its breeding place was found in Santariškės. It was common in the feeding places in Baltupiai, Šeškinė and Jeruzalė (see fig. 1). It is very rare in hibernacula; just single individuals were found in Šilas, Paneriai tunnel and Šeškinė. The northern bat (*Eptesicus nilssonii*) was registered in summer as well as in hibernacula in Þilas, Pavilnys and Verkiai.

The particoloured bat (*Vespertilio murinus)* was registered only once, in the autumn of 2001 (R. Kazlauskas pers. comm.)

The brown hare (*Lepus europaeus*) was registered in the urban zone and suburbs. Hares are common in collective gardens. The mountain hare (*Lepus timidus*) is rare in the city; it was registered in Baltupiai in 1998 (S. Pakalniðkis pers. comm.) and in the environs of Rudamina.

The red squirrel (*Sciurus vulgaris*) is common in all forested areas of the city, but not abundant.

The Eurasian beaver (*Castor fiber*) is abundant on the shores of Gulbinas and Balsys lakes (Þalieji Eþerai, see fig. 1), inhabits ponds in Verkiai, shores of the Neris River in the territory of Vingis Park, it was registered in the Sudervėlė rivulet and Pilaitė ponds (Morkvėnas 1999).

The common dormouse (*Muscardinus avellanarius*) was breeding in the Turniškė forest grooves (Knystautas 1972). In 2001 life signs were registered in Þalieji Eþerai, environs of Balsys Lake (leg. J. Kuliešiūtė, det. R. Juškaitis).

The northern birch mouse (*Sicista betulina*) was registered in the environs of Vilnius city in 1984 (leg. S. Gruodis, det. R. Mažeikytė).

The bank vole (*Clethrionomys glareolus*) is the most common rodent in all city forests, parks and shrubby places. It was found on the Nėris shores (12 ind. per 100 traps/day in 1996), in Pilaitė (4–40 ind. per 100 traps/day in 1999), Visoriai (20 ind. per 100 traps/day in 2002).

The water vole (*Arvicola terrestris*) was registered in the Nėris River and Baltžis Lake near Pilaitė (Morkvėnas 1999).

The root vole (*Microtus oeconomus*) was trapped in swampy areas of the Nėris valley (Čivilytė 2002). The short-tailed vole (Microtus agrestis) was trapped in the meadows near water bodies. It is common in the damp environs of Santariškės. The common vole (*Microtus arvalis* s.str.) is common in open city areas, meadows and pastures (Čivilytė 2002). The sibling vole (*Microtus rossiaemeridionalis*) was registered in 1969 in Jeruzalė. Currently, this territory is built up (Mažeikytė et al. 1999).

The harvest mouse (*Micromys minutus*) was common in the northern part of the city in wasting meadows of Santariškės and Jeruzalė. In Pilaitė

environs it was not abundant with 0.93±0.68 ind. per 100 traps/day (Morkvėnas 1999).

The striped field mouse (*Apodemus agrarius*) habitats in the city are scarce. They were abundant in fragmented fields and gardens. The highest abundance of this species in Visoriai (meadows and deciduous groove, in 1998 and 2002) was 16.0 and 20.0 ind. per 100 traps/day. In the cold February of 2005 it was seen in Justiniškės(M. Balčiauskaitė pers. comm.). The yellow-necked mouse (*Apodemus flavicollis*) inhabits most of the city's forested areas and is more abundant in deciduous stands. In Visoriai forest grooves, the abundance of these animals was 11.1 ind. per 100 traps/day in the summer of 1998, and 20.0 ind. per 100 traps/day in 2002. In Pilaitė environs, the autumnal abundance of mice in 1999 varied from 8 to 40 ind. per 100 traps/day (Morkvėnas 1999). The wood mouse (*Apodemus sylvaticus*) in the territory of Vilnius was found only once (in Pilaitė environs, 1999) and was not abundant with 0.4 ind. per 100 traps/day (Morkvėnas 1999).

The house mouse (*Mus musculus*) is very common in the city, inhabiting buildings (up to the 17th floor) and suburb houses. In summer mice were registered in Pilaitė environs (Morkvėnas 1999) and Visoriai, but their abundance was not high (up to 11 ind. per 100 traps/day.)

The brown (Norway) rat (*Rattus norvegicus*) is also common in the city and found in the buildings, especially where products are stored. The black rat (*Rattus rattus*) was registered in Verkiai environs in 1987, 1988 and 1996, when single specimens were trapped.

The muskrat (*Ondatra zibethicus*) is usually registered in the Neris River in spring after flood, looking for the best places to settle down. It is periodically found in old ponds in Pilaitė environs.

The red fox (*Vulpes vulpes*) is very common in the outskirts of the city, visiting also built-up areas (garbage cans, yards, etc.). Higher abundance was registered in the northern part of Vilnius, in Verkiai forests, Pilaitė and Justiniškės environs.

The racoon dog (*Nyctereutes procyonoides*) inhabits outskirts of the city, breeds on Verkiai hills. Currently, its abundance is decreasing.

The pine marten (*Martes martes*) is abundant and well spread in the forested areas of Vilnius city. It is registered near farmsteads in the outskirts; it visits buildings that stand near the forest edge. The beech marten (*Martes foina*) in Vilnius is not rare and inhabits even the central part of the city.

The weasel (*Mustela nivalis*) is not rare in the outskirts and not built-up areas. Tracks were registered on snow in many remote forested areas, sometimes in quite unusual inhabited areas (territory of Santariškės Hospital, the central square of Vilnius Pedagogical University). The stoat (*Mustela erminea*) was registered in the last years in Verkiai forests. According to foresters, earlier it was more common in the suburbs.

The American mink (*Mustela vison*) is registered near the Neris River and its small affluent, Gulbinas, Balsys and smaller lakes. They use beaver burrows and houses. The polecat (*Mustela putorius*) is frequent in the suburbs and outskirts of the city. It prefers water bodies and swampy areas. Abundance is decreasing.

The badger (*Meles meles*) was registered in the forests of the northern edge of Vilnius and in a mixed forest in Verkiai. Badger sets here are known for a long time. Despite of growing recreational load, badgers are still successfully breeding in these areas of the city.

The otter (*Lutra lutra*) is common in the Neris River; its life signs can be found on stones and near confluences with smaller rivulets in Verkiai. It was registered in the Sudervėlė rivulet and ponds near Pilaitė (Morkvėnas 1999).

The brown bear (*Ursus arctos*) was registered in the city area only once, in 2003, near Þalieji Eþerai.

In 2004 brown bears were seen twice outside the city area, near Nemenčinė. In both cases these animals may have been wandering, as there is no their permanent population in the country (Balčiauskas et al. 1999).

The wild boar (*Sus scrofa*) is common, but not abundant in northern outskirts. If oak mast is abundant, they reach even Verkiai Park for feeding.

The roe deer (*Capreolus capreolus*) is mainly registered in the northern part of the city – Verkiai forests, Kalnų Park (urbanized zone) and Paneriai forests, Pilaitė environs. In winter period, a group of 5–6 animals reach Baltupiai and Jeruzalė, staying in collective gardening areas.

The red deer (*Cervus elaphus*) and moose (*Alces alces*) just visit northern outskirts; they no more stay here permanently. In earlier decades both species inhabited Verkiai forests and environs of Þalieji Eþerai lakes.

Discussion

The mammal diversity in the territory of Vilnius city was found to be surprisingly high, exceeding that in theriologically well-investigated administrative districts or national parks of Lithuania. In the Dzūkija National Park, 43 mammal species were registered, excluding bats (Ulevičius, Juðkaitis 2003); in the Þemaitija National Park, 49 species (Ulevičius et al. 2002); in the Kamanos Strict Nature Reserve, 42 species (Mačiulis 2002). Biodiversity investigation projects yielded much lower mammal species numbers in the administrative districts of Lithuania: 41 in Radviliðkis district, 34 in Šalčininkai district and 38 in Telšiai district (Balčiauskas et al. 1997).

Even in the urbanized territory, a lot of synantropic and hemisynantropic mammal species were registered in some cities. Here we compare the data of Brno agglomeration (Pelikan et al. 1983), Riga (Zorenko, Leontjeva 2003), Kyiv (Zagorodniuk 2003) and Moscow (Tichonova et al. 2004). The highest numbers of mammal species were found in Kyiv – 61 (Zagorodniuk 2003), 53 species in Brno agglomeration (Pelikan et al. 1983), 51 species in Vilnius (our data), 47 species in Kaunas town, though we do not have a full list of species in the publication cited (Kauno... 2005), 27 species in Riga city (Zorenko, Leontjeva 2003), 21 species in Ðiauliai town (Budrys 2005), 16 species of rodents and insectivores were registered in Moscow city (Tichonova et al. 2004). As a rule, rodents and insectivores are the best investigated groups. A considerably less number of mammals penetrate into the most urbanized centers of towns and cities (Table 2).

Thus, the urban zones of various cities host different numbers of mammals. The biggest share – 70% of the total registered city mammals – was found in the urbanized zone of Riga, 60% in the urbanized zone of Brno agglomeration, 57% in the urbanized zone of Vilnius city, and merely 38% in the urban zone of Kyiv. This may be related to several peculiarities of the city: history, built-up areas (modern or ancient), habitat composition, presence of water bodies and the territory included into the city zone. According to maps and habitat descriptions presented in the cited sources (Pelikan et al. 1983, Zorenko, Leontjeva 2003, Zagorodniuk 2003) and our data, the highest habitat diversity and the broadest zones of outskirts were in Kyiv and Brno, followed by Riga and, finally, Vilnius. The Moscow city data are incomparable in this respect as investigations there were limited to grassy formations only (Tichonova et al. 2004). The presented data show that habitat diversity and presence of a wide green zone, outskirts and other less urbanized habitats directly determine the overall number of mammal species registered (Table 2). On the other hand, there are mammals with synantropic or hemisynantropic tendencies prevailing, and these species prefer urbanized habitats.

One of such species is the lesser white-toothed shrew (*Crocidura suaveolens*) registered only in Brno agglomeration, including the urbanized zone. The eastern hedgehog (*Erinaceus*

Table 2. Comparison of mammal species compositions in the urbanized zones of Vilnius, Brno, Riga, Kyiv and Moscow cities and their suburbs (green zones, environs)

Erinaceus concolor	+	+	+	+	+	+	+	+	
Erinaceus europaeus			+	+					
Talpa europaea	+	+	+	+	+	+	+	+	+
Sorex minutus	+		+				+		+
Sorex araneus	+	+	+	+	+		+	+	+
Neomys fodiens	+		+				+		+
Neomys anomalus			+				+		
Crocidura leucodon							+?		
Crocidura suaveolens			+	+			+	+	
Rhinolophus ipposideros			+	+					
Myotis dasycneme	+	+			+	+	+		
Myotis daubentonii	+	+	+	+	+	+	+	+	
Myotis myotis			+	+					
Myotis brandtii	+	+					?		
Myotis nattereri							?		
Myotis emarginatus			+						
Plecotus auritus	+	+	+	+	+	+	+	+	
Plecotus austriacus			+	+					
Barbastella barbastellus	+	+	+				+		
Nyctalus noctula	+		+	+	+	+	+	+	
Nyctalus leisleri	+						+		
Nyctalus lasiopterus							+		
Pipistrellus nathusii	+	+	+		+	+	+	+	
Pipistrellus pipistrellus			+	+	+	+	+	+	
Pipistrellus pygmaeus							+		
Pipistrellus kuhlii							+	+	
Eptesicus serotinus	+	+	+	+			+	+	
Eptesicus nilssonii	+	+			+	+	+		
Vespertilio murinus	+	+					+	+	
Sciurus vulgaris	+	+	+	+	+	+	+	+	
Citellus citellus			+						
Castor fiber	+	+			+	+	+		
Muscardinus avellanarius	+		+	+			+		
Glis glis			+	?			+	+	
Dryomys nitedula							+		
Sicista betulina	+						+		
Clethrionomys glareolus	+	+	+	+	+		+	+	+
Cricetus cricetus			+				+		+
Arvicola terrestris	+		+				+		+
Microtus oeconomus	+						+		+
Microtus agrestis	+								+
Microtus arvalis	+	+	+	+	+		+	+	+
Microtus rossiaemeridionalis	+				+	+	+	+	+
Pitymys subterraneus			+				+		
Micromys minutus	+		+				+		+
Apodemus agrarius	+	+			+	+	+	+	+
Apodemus flavicollis	+	+	+		+	+	+		
Apodemus sylvaticus	+		+	+			+	+	
Apodemus uralensis			+	+	+	+	+		+
Mus musculus	+	+	+	+	+	+	+	+	+
Rattus norvegicus	+	+	+	+	+	+	+	+	+
Rattus rattus	+				+				
Ondatra zibethicus	+	+	+		+	+	+		
Myocastor coypus							+	(+)	
Lepus europaeus	+	+	+	+	+	+	+		
Lepus timidus	+								
Oryctolagus cuniculus			+	+					

Canis lupus							+		
Vulpes vulpes	+	+	+	+	+	+	+		
Canis familiaris			+	+					
Nyctereutes procyonoides	+						+		
Martes martes	+		+		+		+		
Martes foina	+	+	+	+			+	+	
Mustela erminea	+		+	+			+		
Mustela nivalis	+	+	+	+			+		
Mustela vison	+	+					+		
Mustela putorius	+	+	+	+			+	+	
Mustela eversmanni			+						
Meles meles	+		+				+		
Ursus arctos	+								
Lutra lutra	+	+					+		
Felis libyca f. catus			+	+					
Capreolus capreolus	+	+	+	+	+		+		
Cervus elaphus	+		+				+		
Cervus Nippon			+				+		
Cervus dama			+						
Alces alces	+						+		
Sus scrofa	+		+	+	+		+		
Ovis musimon			+						
Total:	51	29	53	32 (33)	27	20	61	23 (24)	16

* – in Moscow, only rodents and insectivores were registered
? – not clear
(+) – possibly escaped from cages

concolor), European mole (*Talpa europaea*) and common shrew (*Sorex araneus*) are other examples of insectivore species that tend to be at least not avoiding built-up territories of the cities. Common and water shrews were not registered in Riga, but they are expected to be there according to the species range (Mitchell-Jones e al. 1999).

Bats are a mammal group, which do not avoid urbanized territories, at least for wintering. While the highest number of bat species was registered in Kyiv city (Zagorodniuk 2003), some of these species, as well as those inhabiting Brno (Table 2), could not be found further to the north. Thus, distribution ranges of the lesser horseshoe bat (*Rhinolophus hipposideros*), greater mouse-eared bat (*Myotis myotis*), Geoffroy˙s bat (*M. emarginatus*), greater noctule (*Nyctalus lasiopterus*) and Kuhl˙s pipistrelle (*Pipistrellus kuhlii*) do not cover Lithuania (Mitchell-Jones et alt. 1999). We expect, that a list of bats may become longer in Vilnius as well as in Riga.

Rodents are the best-represented mammal order (table 2). In all cities concerned, the house mouse (*Mus musculus*), brown rat (*Rattus norvegicus*) and red squirrel (*Sciurus vulgaris*) were registered, tending also to urbanized zones. Two other species, i.e. bank vole (*Clethrionomys glareolus*) and common vole (*Microtus arvalis*), were also registered in all cities, but not found in the central part of Riga (Zorenko, Leontjeva 2003).

Some other rodent species are also widespread in the cities, such as the harvest mouse (*Micromys minutus*) and the water vole (*Arvicola terrestris*), except in Riga, the yellow-necked mouse (*Apodemus flavicollis*) and the muskrat (*Ondatra zibethicus*), except in Moscow city. The striped field mouse (*Apodemus agrarius*) and the sibling vole (*Microtus rossiaemeridionalis*) were registered in all cities, except Brno agglomeration, but for these two species the distribution range is too narrow (Mitchell-Jones et al. 1999).

The only species of carnivores inhabiting all cities and penetrating into their urbanised zones is

the red fox (*Vulpes vulpes*). The pine marten (*Martes martes*) inhabits the outskirts of all mentioned cities (Table 2). The beech marten (*M. foina*) was not registered in Riga, but in 1999–2002 two species were found in this city for the first time (Zorenko, Leontjeva 2003), though authors mention three more species (American mink, polecat and otter) registered in the city earlier. According to the cited literature, stray domestic dogs and cats are problematic species only in Brno agglomeration (Pelikan et al. 1983).

Ungulates do not inhabit urbanized pats of the cities; exceptions are the roe deer (*Capreolus capreolus*) in Vilnius and Brno and the wild boar (*Sus scrofa*) registered in the urbanized zone of Brno agglomeration.

Conclusions

1. The diversity of mammal fauna in Vilnius city is very rich. More than 75% of all Lithuanian mammal species (51 out of 65) was registered in Vilnius during 1982–2005. Fourteen species: pond bat, Brandt˙s bat, barbastelle, brown long-eared bat, noctule, Leisler˙s bat, serotine bat, northern bat, particoloured bat, northern birch mouse, mountain hare, stoat, brown bear and otter – are included into the Red Data Book of Lithuania.

2. 29 mammal species (57% of the total) were registered in the urbanized part of Vilnius; this percentage is comparable with that of Brno agglomeration (60%) and is higher than in Kyiv (38%).

3. Mammals inhabiting urbanized parts of most cities are as follows: house mouse and brown rat (synantropic species), eastern hedgehog, European mole, common shrew, bank vole, common vole and red fox. Other species, such as harvest mouse, water vole, yellow-necked mouse, muskrat, striped field mouse, sibling vole, pine marten, beech marten, roe deer and wild boar, are well established in the outskirts.

4. Quite synantropic are many bat species, but some of them were registered in the urbanized parts of the cities in hibernacula only.

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AVIAN PREDATOR PELLET ANALYSIS IN BIODIVERSITY AND DISTRIBUTION INVESTIGATIONS

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Balčiauskienė L., Skuja S., Zub K. 2005. Avian predator pellet analysis in biodiversity and distribution investigations. *Acta Biol. Univ. Daugavpil., 5 (1): 67 - 73.*

This paper shows that even a comparatively small pellet sample can contribute to the knowledge of biological diversity and distribution of certain animal species. Food remains from nests and pellets of the Lesser Spotted Eagle (*Aquila pomarina*), Common Buzzard (*Buteo buteo*), Goshawk (*Accipiter gentilis*), Tawny Owl (*Strix aluco*) and Ural Owl (*S. uralensis*) collected in summers 2003–2004 in the Biržų Giria forest (covering three 10x10 UTM squares – LC4a2, a3, and b3) were analysed. Four new small mammal species and one new amphibian species for the territory were found. Among them, there was a new record of the birch mouse (*Sicista betulina*), a Red-Listed species in Lithuania and a new record of the common dormouse (*Muscardinus avellanarius*). In 2003 two new records – one of *S. betulina*, and one of the water vole (*Arvicola terrestris*) were registered in the Žemaitija National Park, Liepijų forest. Thus, two new sites of *S. betulina* are added, demonstrating high sensibility of the method for faunistic research.

Key words: birds of prey, Tawny Owl, pellet analysis, small mammals, northern birch mouse, Biržų Giria forest

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Introduction

Pellets of avian predators are a source material for the estimation of biodiversity in a locality as they contain the remains of small mammals (mostly rodents, insectivores, occasionally bats and carnivores), birds, amphibians, insects and, rarely, reptiles (Mikkola 1983, Cramp 1998). A pellet analysis is an un-invasive method preferred, therefore, for the inventorying of rare species. It also shows species that are hardly registered by trapping (Yalden & Morris 1990). The diet composition of birds of prey may be studied using different methods. The most common is the pellet analysis. Several overviews of this subject (Glutz & Bauer 1980, Mikkola 1983, Cramp 1998)

and a number of publications (? ??åö??é 1961, Korpimäki 1992, Ää? ?? ÷?? 1993, Jędrzejewski et al. 1996) are available. An analysis of prey remains found in the nests after the breeding period is also possible, but not so common (Southern 1969, Holmberg 1976, Lundberg 1980, Zvaral, Obuch 1996).

In Lithuania, there are not many publications on the diet analysis of predatory birds and owls, most of these related to the analysis of owl pellets and food remains (Drobelis, Šablevičius 1982, ? ó? ?ó?? ? 1982, Rumbutis 1986, Balčiauskienė et al. 2000, Balčiauskienė et al. 2000/2001, Balčiauskienė et al. 2005).

The aim of this presentation is to show how a comparatively small sample of pellets and food remains can contribute to the knowledge of biological diversity and distribution of rare or hardly trappable small mammal species.

Material and methods

We analysed pellets and food remains of the Lesser Spotted Eagle (*Aquila pomarina*), Common Buzzard (*Buteo buteo*), Goshawk (*Accipiter gentilis*), Tawny Owl (*Strix aluco*) and Ural Owl (*S. uralensis*) collected in summers of 2003–2004. Five cases of food remains from nests, 25 pellets (9 of them were partly destroyed) and 5 samples of destroyed pellets were analysed in the Biržų Giria forest. The Biržų Giria forest (the very north of Lithuania, from Vecmemele to Iesalnieki in Latvia) covers three 10x10 UTM squares – LC4a2, a3, and b3 (Fig. 1). The forest is characterised by various stands (including broad-leaved, mixed deciduous and swampy). It is one of the main timber sources in the region. Out of 17,300 ha there are 900 ha of key forest habitats in the Biržų Giria forest. Currently, a great part of this forest is under Natura 2000 network.

Characteristics of habitats, where pellets and prey remains were collected:

1. three sites of maturing and mature ash (*Fraxinus excelsior*) stands, mixed with spruce (*Picea abies*), poplar (*Populus tremula*), black alder (*Alnus glutinosa*) and single oak (*Quarcus robur*) trees;
2. five sites of mature spruce stands, mainly waterlogged, mixed with birch (*Betula pendula*) and/or poplar trees, overgrown with sedges, bilberries or peat-mosses;
3. one site of mature pine (*Pinus sylvestris*) stand, overgrown with sedges and peat-moss;
4. four sites of maturing and mature waterlogged black alder stands of dropwort- or reedgrass-type, mixed with birch, ash and spruce trees.

This pellet sample was compared with the data from the Atlas of Lithuanian Mammals, Amphibians and Reptiles (Balčiauskas et al. 1999). The atlas data were collected using a wide range of methods, including small mammal trapping; a pellet analysis was not employed.

Two partly destroyed pellets were collected in the Þemaitija National Park (west Lithuania), Liepijų forest, in 2003. Habitat type – overmature oak (*Quercus robur*) shamrock-type stand with mature spruce trees.

Small mammals were identified from undigested prey remains, mainly bones according to Pucek (1984), März (1987), Prūsaitė et al. (1988) and Turni (1999) and our own collection of skulls. The tooth row length was used for identification in case of incomplete skulls (Balčiauskienė et al. 2002). Even a single bone identifying a species was treated as an individual of a given species (Raczynski & Ruprecht 1974; Yom-Tov & Wool 1997). Amphibians were identified according ilium (März 1987). Feet and feathers of birds, as well as heads, jaws, legs and wing covers of insects were used for identification. The failure to distinguish between pellets of different predatory species is acceptable when the aim of the study was just to identify prey characteristics (Beacham 1979). Thus, we included cases where avian predators were not identified to the species.

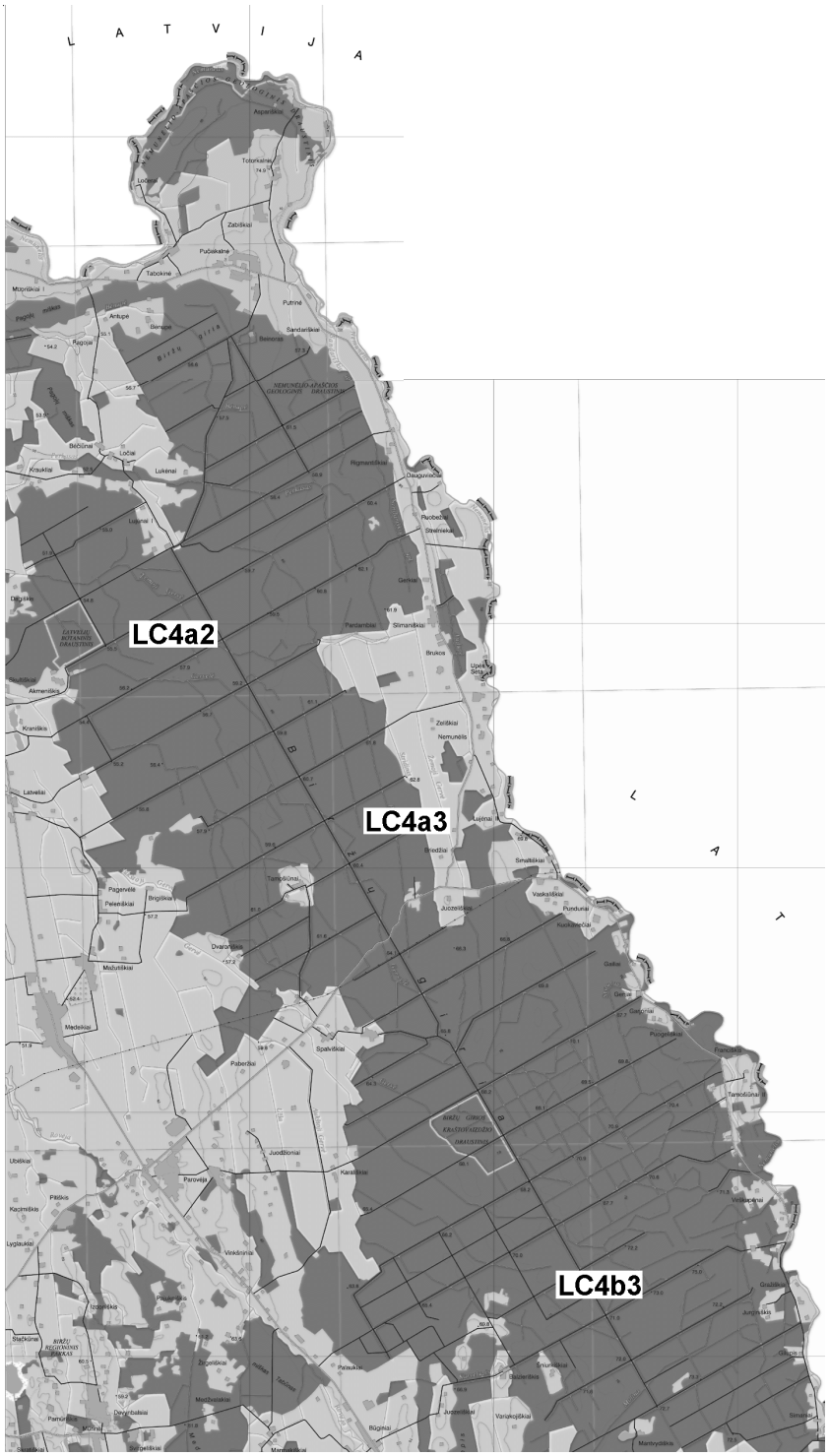

Figure 1. Study sites in the Bir?¸ Giria forest, 2003–2004, with UTM 10x10 km square notification

Results

The analysis of pellets and food remains of the Lesser Spotted Eagle (*Aquila pomarina*), Common Buzzard (*Buteo buteo*), Goshawk (*Accipiter gentilis*), Tawny Owl (*Strix aluco*) and Ural Owl (*S. uralensis*) yielded a list of prey species. In the UTM squares LC4a2 and a3 eight species of mammals and two species of amphibians, namely the eastern hedgehog (*Erinaceus concolor*), common mole (*Talpa europaea*), pygmy shrew (*Sorex minutus*), bank vole (*Clethrionomys glareolus*), common vole (*Microtus arvalis*), yellow necked mouse (*Apodemus flavicollis*), common dormouse (*Muscardinus avellanarius*), weasel (*Mustela nivalis*), common frog (*Rana temporaria*) and moor frog (*Rana arvalis*) were found. In the territory, covered by UTM square LC4b3, the common mole (*Talpa europaea*), common shrew (*Sorex araneus*), bank vole (*Clethrionomys glareolus*), common vole (*Microtus arvalis*), yellow-necked mouse (*Apodemus flavicollis*), northern birch mouse (*Sicista betulina*) weasel (*Mustela nivalis*), common frog (*Rana temporaria*) and moor frog (*Rana arvalis*) were present. Also, beetles (*Carabidae, Silpha, Dytiscus, Melolontha*) and passerine birds, undetermined to a species level, were found. Habitat where *S. betulina* was found in pellet was waterlogged mature black alder (*Alnus glutinosa*) stand with ashes (*Fraxinus excelsior*) spruce (*Picea abies*) and birch (*Betula pendula*).

The Ural Owl (*S. uralensis*) is one of protected bird species of the Biržų Giria forest. It is one of the least known bird species in Lithuania included into Red Data Book, category 4(I). It is presumed that the Ural Owl population numbers depend on the availability of its main food source – rodents and small birds; other foods – moles, hedgehogs, squirrels, amphibians and insects are not so common. Nests are made in the hollows, trunks of trees, suitable nest-boxes and in the nests of birds of prey. Only two forest tracts (Biržų Giria and Adutiðkis) were designed to protect this species in Lithuania as they support local populations of this species (http://www.birdlife.lt). In our sample of *S. uralensis* pellets *Clethrionomys glareolus*, *Rana temporaria*, unidentified species of birds and parts of g. *Dytiscus* beetle were present.

Two new records – one of the water vole (*Arvicola terrestris*), and one of *Sicista betulina* were added to the Atlas from the Þemaitija National Park, Liepijų forest in 2003 from just two partly destroyed pellets. Habitat where *S. betulina* was found in pellet was overmature oak (*Quercus robur*) stand with mature spruce trees.

Discussion

We compared the list of mammal and amphibian species, identified from pellets and prey remains in the sample, with data from the Atlas of Lithuanian Mammals, Amphibians and Reptiles (Balčiauskas et al. 1999). Though a number of species retrieved from the bird diet was considerably less, some mammals and amphibians were registered for the first time (Table 1).

Table 1. The Atlas data for UTM squares in the Biržų Giria forest and the supplement from the pellets and prey remains.

Table 1. The atlas data for UTM squares in the Bir?¸ Giria forest and the supplement from the pellets and prey remains

	LC4a2	LC4a3	LC4b2	LC4b3	LC4b4
Total No. of mammal species found	16	21	29	27	23
small mammals*	1	4	18	10	8
No. of herp species found	0	3	8	7	1
No of small mammal species found in pellets	6		-	7	-
No of herp species found in pellets	2		-	2	-
New small mammal species	4		-	2	-
New herp species	1		-	1	-

Thus, even a small pellet sample yielded a considerable supplement to the distribution data, by adding *Apodemus flavicollis*, *Clethrionomys glareolus*, *Microtus arvalis*, *Sorex minutus* and *Rana arvalis* to LC4a2/a3 square, and the *Talpa europaea*, *Sicista betulina* and *Rana temporaria* to LC4b3 square. We made a new record of *Sicista betulina*, a Red-Listed Species in Lithuania. Also, a new record of *Muscardinus avellanarius* was made ca. 5 km away from that described in the Atlas.

Another record of *S. betulina* from the Þemaitija National Park is also a new one. All above-mentioned localities for *S. betulina* were not included in the latest review of species distribution in Lithuania (Juðkaitis 2004). Thus, we add two new sites of this species to 40 already known. Liepijų forest is in a different UTM square, not covered in the Atlas and the review of mammal species in the Žemaitija National Park (Ulevičius et al. 2002). The Biržų Giria forest is the first occurrence of *S. betulina* in the very north of the country. Both sites are characterised as mature or overmature deciduous stands (black alder, ash and oak) with mature spruce trees.

Owls are effective predators – in their pellets a number of species of small mammals can be found that would take an extensive trapping effort to obtain. We compared the data on the Tawny Owl diet from the prey remains found in nest-boxes after the breeding period in 1997–2004 in Kėdainiai district and in 1999–2003 in the Kamanos State Strict Nature Reserve with the results of small mammal monitoring in these territories. The number of these species found in prey remains and their diversity was always greater than that obtained by trapping. On average, 12.1±0.9 and 11.3±1.9 species were recovered from prey remains, while the number of species trapped was 7.0±0.6 and 6.8±1.7 accordingly. Shannon˙s H in prey remains was 2.62±0.11 and 2.80±0.14 vs. 1.97±0.13 and 1.65±0.33 (Balčiauskienė 2005).

In Þakiai district, prey remains from 11 nestboxes occupied by owls in 1986–1987 and 1997–2004 during the breeding period (April–May) yielded a list of 15 small mammal, 18 bird, two amphibian species and two genera of insects (Balčiauskienė et al. 2005).

In our earlier investigations, *S. betulina* was found in the pellets or prey remains of the Tawny Owl for several times: in the Kurtuvėnai Regional Park (Balčiauskienė et al. 2000/2001) and Kamanos State Strict Nature Reserve (Balčiauskienė et al. 2005), where it formed 3.5% and 0.6% of the total items of small mammals, respectively. On the other hand, eight-year-long investigations of the Tawny Owl diet in Kėdainiai district (Balčiauskienė et al. 2000, Balčiauskienė 2005) and ten-year-long investigations in Þakiai district (Balčiauskienė et al. 2005) did not reveal any presence of *S. betulina*. According to the latest data, ca. 30% of the total number of *S. betulina* findings in Lithuania were done by analyzing owl diet (Juðkaitis 2004). Having in mind the effectiveness of owl hunting, we presume the absence of this species in the given locations.

Conclusions

1. Birds of prey, especially owls, are highly effective in preying small mammals. This feature may be employed in biodiversity investigations as pellets and prey remains give information not only on the presence of mammal species in the territory, but also on birds, amphibians and insects.
2. Smallest numbers of pellets, even a single one, may give information on the presence of rare small mammal species, hardly obtainable by trapping.
3. From a quite small sample of pellets and prey remains, two new localities of the northern birch mouse (*Sicista betulina*) were added to 40 ones already known.
4. Both sites where *S. betulina* was recorded are characterised as mature or overmature deciduous stands (black alder, ash and oak) with mature spruce trees.

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SEASONAL DIET DIVERSITY OF RACCOON DOG (*NYCTEREUTES PROCYONOIDES* GRAY) IN DIFFERENT LANDSCAPES, LITHUANIA

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Baltrūnaitė L. 2005. Seasonal diet diversity of raccoon dog (*Nyctereutes procyonoides* Gray) in different landscapes, Lithuania. *Acta Biol. Univ. Daugavp., 5 (1): 75 - 83.*

Seasonal diet and food niche breadth of raccoon dog was studied in three different types of landscape in Lithuania – in sandy plains, clay plains and moraine highlands. Diet of raccoon dog was studied by faecal analysis. Biomass consumed and frequency of occurrence was evaluated. Food niche breadth was determined using standardized Levin˙s index (B_A). Ungulate carcasses, rodents, insectivores, birds, amphibians, invertebrates, and plants prevailed in the diet. Consumption of all components varied with season. Such differences of food consumption were related to seasonal changes of food abundance and availability. The broadest food niche was characteristic in spring and summer (0.28–0.40 and 0.16–0.36, respectively), when raccoon dog consumed diverse abundant food. In autumn-winter seasons, because of shortage of food resources, food niche breadth became narrower. In sandy plains and moraine highland, the narrowest food niche was established in autumn (0.18–0.19), in clay plains – both in autumn and winter (in both cases 0.09). Comparing diet between landscapes, significant differences were established both in annual and seasonal consumption of several food items. Different diet of raccoon dog in study sites was a result of a different abundance of food resources, which in its turn is conditioned by habitat structure of study areas. Raccoon dog fed on more diverse food in ecosystems with homogeneous habitat structure (sandy plains) or in ecosystems with high level of habitat fragmentation (moraine highlands).

Key words: raccoon dog, diet, food niche breadth, landscapes, Lithuania

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Introduction

Raccoon dog (*Nyctereutes procyonoides* Gray) is invasive species for Lithuania. Natural range of this predator is Far East, Asia. In 1929-1955, raccoon dog was introduced in north-west part of former USSR and spread both in other regions of former USSR and neighboring Europe countries. The predator first appeared in Lithuania in 1948 from Belarus and later from Poland and spread all over the country during 12 years (Prūsaitė et al. 1988). Abundance of raccoon dog fluctuated and reached about 7500 in 1997 (Balčiauskas et al. 1999).

Detailed investigations on various aspects of raccoon dog˙s biology were carried out in Finland (Helle, Kauhala 1991, Kauhala et al. 1993a, 1993b, 1998, Kauhala 1996a, 1996b), Poland (Kobylińska 1996, Jędrzejewska & Jędrzejewski

1998, Goszczyński 1999), Belarus (Sidorovich et al. 2000), Russia (Morozov 1953, Danilov et al. 1979). In Lithuania, there is some data on raccoon dog˙s densities, burrow use (Bluzma 1990, Ulevičius 1997, Balčiauskas et al. 1999, Mickevičius 2002a, 2002b) and the only one paper dealing with raccoon dog˙s food habit (Prūsaitė, 1960). Meanwhile, one of the most important aspects of raccoon dog˙s ecology in occupied areas is diet research. In future, these studies could help to evaluate possible impact of raccoon dog on native predators and their prey. In many studies, obtained results show marked variation of raccoon dog diet depending both on season and study area (Jędrzejewska & Jędrzejewski 1998, Sidorovich et al. 2000, Kauhala & Auniola 2001). So, the main tasks of this research were: to evaluate seasonal peculiarities of raccoon dog diet, to compare raccoon dog˙s diet in three different types of landscape, to calculate food niche breadth of raccoon dog.

Methods

Habitat structure of ecosystems of study sites was investigated applying the methods of ecosystem structure devised by Sidorovich et al. (2001). List of habitats was modified according to characteristic of ecosystems in Lithuania. 80–100 km long routes were worked out in study sites with help of topographical maps (1:25 000) and plans of forest stands (1:10 000). These routes included whole diversity of habitats proportionally to the area they cover. Habitat type and their sequence were registered along routes, on 50 m long sections. On the basis of data obtained woodenness of study sites, habitat area and indices of ecosystem habitat diversity (number of different habitats per 1 km–long section) and ecosystem fragmentation (the number of habitat fragments per 1 km–long section) were estimated.

The diet of raccoon dog was studied by faecal analysis (June 1999 – May 2002). At raccoon dog˙s latrines, 566 scats were collected. Prior to analysis they were kept deep–frozen. Their analysis was made following standard procedures (Lockie 1959, 1961, Goszczynski 1974). In total, 13 food items were distinguished: insectivores, rodents, hares, ungulate carcasses, carnivores, birds, reptiles, amphibians, fishes, invertebrates, plants, ungulate scats, garbage. Part of these items was identified more precise. Identification of mammals was made according to their teeth, microscopic hair structure (Day 1966, Dziurdzik 1973, Pucek 1981, Teerink 1991). Insects, plants were identified by comparing with the available collection and/or using identification keys (Grigas 1986). Frequency of occurrence (a percentage of the total number of scats) and biomass consumed (according to Jędrzejewska & Jędrzejewski 1998) were calculated. According to prey abundance and availability, seasonal diet was analyzed by distinguishing four seasons: summer (July – September), autumn (October – November), winter (December – March), and spring (April – May). Seasonal and site variation of diet was tested by Kruskal-Wallis test.

Food niche breadth was calculated using Levin˙s standardized niche breadth (B_A): $B_A = B–1/n$, where B is Levin˙s measure of niche breadth ($B = 1/”p^2$, p – proportion of items in the diet that are of food category), n – number of possible food items (Krebs, 1999).

Study area

The investigations were performed in three 120–150 km^2–size study sites located in Anykščiai (55ţ09’N 25ţ20’E), Molėtai (55ţ34’N 24ţ49’E) and Varėna (54ţ06’N 24ţ18’E) administrative districts. These sites are located in three predominant typological landscape groups in Lithuania – clay plains, moraine higlands and sandy plains (Basalykas, 1973). The study area was chosen in respect to include forests with surrounding open lands. According to landscapes names study sites are encoded as “sands” (in sandy plains), “clays” (in clay plains), and “moraines” (in moraine highlands).

Forest made up 87% of the study site “sands” (Table 1). Continuous pine forests (*Pinus*

Table 1. Habitat area of study sites "sands", "clays", and "moraines" in Lithuania

Habitat type	Habitat area, %		
	"Sands"	"Clays"	"Moraines"
Coniferous stands	74.9	20.4	5.6
Broad-leaved stands	5.6	24.6	24.2
Mixed stands	6.2	24.6	13.1
Clear-cuttings	2.0	3.4	1.1
Swamps	3.7	0.7	6.9
Meadows, pastures	4.4	15.1	34.3
Arable land	1.8	8.6	7.7
Rivers, lakes	0.6	1.2	1.0
Villages, homesteads	0.8	1.4	6.0
Habitat diversity*	5.14±0.23	8.93±0.22	10.58±0.31
Habitat fragmentation*	8.24±0.44	14.67±0.4	17.84±0.56

* – average ± SE

sylvestris) were dominant there (72%), soft broad–leaved (birch *Betula pendula*, european alder *Alnus glutinosa*) and mixed stands were not numerous. Not big forest meadows, swamps were typical of the study site.

In study site "clays" forest formations made up 70% (continuous massive with few little close forests). They were dominated by stands of soft broad–leaved trees (birch *Betula pendula*, asp *Populus tremula*) and those of spruce (*Picea abies*) or mixed stands of spruce and soft broad–leaved trees. Open areas (28%), mainly meadows and arable land, constituted a considerable part in study site "clays".

In the study site "moraines" forests (composed of many little groves) made up 43%. It was dominated by stands of soft and mixed soft and hard broad–leaved trees (birch *Betula pendula*, asp *Populus tremula*, european ash *Fraxinus excelsior*, maple *Acer platanoides*, oak *Quercus robur*) as well as those of mixed spruce and broad–leaved trees. Meadows prevailed in open

Table 2. Diet composition of raccoon dog in different seasons in study site "sands" in Lithuania

Food item	Summer		Autumn		Winter		Spring		Annual	
	BC*	FO	BC	FO	BC	FO	BC	FO	BC	FO
Insectivores	7.3	7.8	3.2	11.9	4.8	10.2	5.8	9.3	5.3	9.6
Rodents	13.0	12.5	13.6	23.8	12.8	16.9	7.0	18.5	11.8	17.4
Hares	3.4	4.7	–	–	6.5	3.4	8.4	5.6	4.6	3.7
Carnivores	–	–	–	–	–	–	0.2	3.7	+	0.9
Ungulate carcasses	0.6	3.1	16.4	21.4	39.4	25.4	16.1	11.1	18.6	14.6
Birds	8.6	9.4	2.2	4.8	6.4	6.8	19.1	20.4	8.8	10.5
Reptiles	2.8	3.1	–	–	–	–	–	–	0.8	0.9
Amphibians	19.0	26.6	10.4	9.5	10.2	10.2	27.1	33.3	16.3	20.5
Fishes	2.1	3.1	–	–	–	–	0.8	3.7	0.7	1.8
Invertebrates	10.1	51.6	4.7	26.2	0.3	11.9	14.6	75.9	7.1	42.0
Plants	33.0	42.2	49.1	69.0	19.1	49.2	0.6	13.0	25.8	42.0
Ungulate scats	–	–	0.2	7.1	0.4	8.5	–	–	0.2	3.7
Garbage	0.1	4.7	0.3	7.1	0.1	1.7	0.3	5.6	0.2	4.6
Food niche breadth, B_A	0.36		0.19		0.28		0.40		0.44	
Number of scats	64		42		59		54		219	

* BC – biomass consumed, %, FO – frequency of occurrences, %

areas, quite a big part of which was occupied by arable land and swamps.

Results

In study site "sands", mammals comprised 24.3% of biomass consumed with rodents (*Microtus* voles, *Apodemus* mice, bank voles *Clethrionomys glareolus*) and insectivores (shrews Soricidae, moles *Talpa europaea*) predominating in summer (Table 2). Birds, amphibians, and invertebrates (mainly beetles Coleoptera) were also frequently consumed. The major part of ration fell to plants, mainly fruits of raspberries *Rubus* sp., bilberries *Vaccinium myrtillus*, and apples *Malus* sp.

In autumn, rodents (*Microtus* voles and bank voles) and ungulate carcasses (livestock, wild boars *Sus scrofa*) predominated among mammals. Consumption of birds, amphibians, and invertebrates decreased, whereas plants comprised half biomass consumed. These were red bilberries *Vaccinium vitis-idaea*, cranberries *Oxycoccus palustris*, apples, plums *Prunus* sp., and cereal. In winter, mammals became the most important food (63.5% BC). The main part fell to ungulate carcasses – cervids Cervidae, wild boars, and livestock. Rodents, mainly *Microtus* voles, were also frequently consumed. Among other groups, just amphibians and plants (apples, cranberries) were significant.

In spring, consumption of mammals decreased. Ungulate carcasses (wild boars), rodents (*Microtus* voles), insectivores, and hares were frequently used. Consumption of birds, amphibians, and invertebrates (beetles Coleoptera) sharply increased.

In the course of the year, biomass consumed of ungulate carcasses ($p<0.001$), amphibians ($p<0.01$), invertebrates ($p<0.001$), and plants ($p<0.001$) differed significantly (Kruskal-Wallis test).

In study site "clays", mammals comprised a little part with rodents (*Microtus* voles) predominating in summer (Table 3). Birds, reptiles, amphibians, and invertebrates (mainly earthworms *Lumbricus* sp.) were frequently used. The major part of biomass consumed fell to plants (54.7 % BC). Fruits of apples predominated; raspberries, cereal, and bilberries were also frequent.

In autumn, consumption of mammals sharply increased (81.9% BC). Ungulate carcasses (wild boars, cervids) predominated. Birds, amphibians, invertebrates, plants (apples) were consumed in moderate amount.

Table 3. Diet composition of raccoon dog in different seasons in study site "clays" in Lithuania

Food item	Summer		Autumn		Winter		Spring		Annual	
	BC*	FO	BC	FO	BC	FO	BC	FO	BC	FO
Insectivores	2.1	7.9	1.2	8.2	6.7	14.1	13.2	8.7	6.0	10.3
Rodents	3.9	23.7	14.3	36.7	9.5	23.9	4.1	4.3	9.1	22.5
Hares	–	–	–	–	2.3	2.8	–	–	1.3	1.0
Ungulate carcasses	1.5	2.6	66.4	49.0	68.8	45.1	7.9	4.3	52.5	28.9
Birds	10.7	5.3	3.5	4.1	2.9	5.6	13.4	13.0	5.3	6.9
Reptiles	6.1	2.6	–	–	–	–	1.9	6.5	0.9	2.0
Amphibians	8.1	23.7	0.4	4.1	4.1	11.3	12.3	10.9	4.9	11.8
Invertebrates	12.9	42.1	5.2	71.4	0.8	9.9	41.3	89.1	8.5	48.5
Plants	54.7	73.7	8.9	67.3	4.7	26.8	5.5	32.6	11.3	46.6
Ungulate scats	–	–	–	–	0.2	8.5	0.4	4.3	0.2	3.9
Garbage	+	7.9	0.2	16.3	+	4.2	–	–	+	6.9
Food niche breadth, B_A	0.16		0.09		0.09		0.28		0.18	
Number of scats	38		49		71		46		204	

* BC – biomass consumed, %, FO – frequency of occurrences, %

In winter, mammals remained the main food (87.3% BC). Ungulate carcasses predominated (livestock, wild boars); rodents (mainly *Microtus* voles), insectivores (shrews) were also consumed. Other groups (amphibians, plants) were of minor importance.

In spring, consumption of mammals decreased (25.2% BC). Insectivores (moles) were most frequently used, whereas biomass of ungulate carcasses made just 7.9%. In this season, birds and amphibians were important. Still, the major part of ration fell to invertebrates – beetles and earthworms.

Consumption of rodents ($p<0.001$), ungulate carcasses ($p<0.001$), reptiles ($p<0.05$), amphibians ($p<0.05$), invertebrates ($p<0.001$), and plants ($p<0.001$) differed significantly in the course of the year (Kruskal-Wallis test).

In study site "moraines", mammals comprised the major part of biomass consumed (44.7% BC) in summer (Table 4). Rodents (bank voles, *Microtus* voles, *Apodemus* mice) and insectivores (shrews, moles) were most frequently used. Another important food item was amphibians (23.9% BC), whereas, birds, invertebrates (earthworms, beetles) were consumed in moderate quantities. Plants were also important with raspberries, apples, and pears *Pyrus* sp. predominating.

In autumn, mammals and plants made the bulk of raccoon dog˙s diet. Consumption of rodents decreased, whereas ungulate carcasses˙ (wild boars, livestock, cervids) biomass consumed sharply increased. Among plants, fruits of pears and apples were important.

In winter, the same as in autumn, mammals and plants were the most important food items. Among mammals, ungulate carcasses (the same groups as in autumn), rodents (*Microtus* voles, bank voles), and insectivores (mainly shrews) were frequently consumed. Cereal, apples, and oak˙s acorns (*Quercus robur*) comprised the base of plants consumed.

In spring, among mammals, just ungulate carcasses (wild boars) were important. Consumption of birds, amphibians, invertebrates (beetles) reached the highest values.

Consumption of birds ($p<0.05$), amphibians ($p<0.01$), invertebrates ($p<0.001$), and plants ($p<0.001$) differed significantly (Kruskal-Wallis test).

Comparing diet between study sites, significant differences were established in annual consumption of ungulate carcasses ($p<0.01$), amphibians ($p<0.05$), and invertebrates ($p<0.001$; Kruskal-

Table 4. Diet composition of raccoon dog in different seasons in study site "moraines" in Lithuania

Food item	Summer		Autumn		Winter		Spring		Annual	
	BC*	FO	BC	FO	BC	FO	BC	FO	BC	FO
Insectivores	11.5	20.9	7.8	10.5	19.6	19.6	3.5	5.3	11.8	14.9
Rodents	29.2	32.6	7.4	15.8	20.7	21.4	6.0	23.7	16.0	23.4
Hares	0.2	2.3	2.7	2.6	–	–	5.6	5.3	2.0	2.3
Ungulate carcasses	3.8	7.0	28.8	21.1	36.1	23.2	32.5	26.3	28.1	19.4
Birds	6.4	7.0	1.3	5.3	–	–	14.4	18.4	5.0	6.9
Reptiles	1.7	4.7	–	–	–	–	–	–	0.3	1.1
Amphibians	23.9	30.2	2.7	13.2	3.4	5.4	27.5	26.3	13.0	17.7
Fishes	0.1	2.3	0.9	5.3	–	–	0.1	5.3	0.2	2.9
Invertebrates	7.7	51.2	0.6	28.9	0.3	7.1	9.8	65.8	4.1	35.4
Plants	15.5	44.2	47.5	60.5	19.5	50.0	0.1	5.3	19.3	41.1
Ungulate scats	–	–	0.2	5.3	0.4	7.1	0.4	7.9	0.3	5.1
Garbage	+	2.3	–	–	+	1.8	0.2	5.3	0.1	2.3
Food niche breadth, B_A	0.35		0.18		0.25		0.30		0.39	
Number of scats	43		38		56		38		175	

* BC – biomass consumed, %, FO – frequency of occurrences, %

Wallis test). Raccoon dog˙s diet was also compared in separate seasons. Most differences were typical of raccoon dog˙s diet in spring – consumption of rodents ($p<0.05$), ungulate carcasses ($p<0.05$), reptiles ($p<0.05$), amphibians ($p<0.05$), invertebrates ($p<0.001$), and plants ($p<0.001$) differed significantly. The least differences in diet were noticed in summer (rodents, $p<0.05$ and plants, $p<0.01$) and winter (ungulate carcasses, $p<0.05$ and plants, $p<0.001$). In autumn, consumption of ungulate carcasses ($p<0.01$), invertebrates ($p<0.001$), and plants ($p<0.05$) differed significantly between study sites.

The broadest food niche was characteristic in spring and summer (0.28–0.40 and 0.16–0.36, respectively), when raccoon dog consumed diverse abundant food (Tables 2–4). In autumn–winter seasons, food niche breadth became narrower because of shortage of food resources. In study sites "sands" and "moraines", the narrowest food niche was assessed in autumn (0.18–0.19), in study site "clays" – both in autumn and winter (0.09). All year round, the broadest food niche was typical to raccoon dog in study sites "sands" and "moraines", the narrowest – in study site "clays".

Discussion

Obtained results showed reliable differences in raccoon dog˙s diet, which depended both on season and study site. This predator is typical omnivorous, which feeds on any available and abundant food (Kauhala et al. 1993b, Sidorovich et al. 2000). Ungulate carcasses, rodents, insectivores, amphibians, invertebrates, and plants made the bulk of raccoon dog˙s diet in Lithuania. Similar diet composition is typical to this predator in many studies (Kauhala et al. 1993b, 1998, Jędrzejewska & Jędrzejewski 1998, Sidorovich et al. 2000), still, importance and biomass consumed of food groups varied markedly.

Among mammals, three groups were important for raccoon dog – insectivores, rodents, and ungulate carcasses. Importance of insectivores depended on study site, reaching highest values in moraine highlands. No clear seasonal dependence was noticed for insectivores˙ intake. Jędrzejewska & Jędrzejewski (1998) notice that consumption of insectivores (shrews) is nearly as common as rodents. Our results showed remarkably higher importance of rodents. Consumption of latter food group depended both on season and study site. The least amount of rodents in diet was typical to spring, when rodents˙ abundance was the least, and increased in other seasons. The highest values of rodents biomass consumed were typical to moraine highlands. Kauhala (1993b) supposes that rodents are favorite food for raccoon dog. In northeastern Poland, Biebrza River Valley rodents make the bulk of diet all year round (Kobylińska 1996). Our results didn˙t show reliable preference of raccoon dog to rodents and were more similar to results obtained in Belarus, Poland, Bialowieza National Park with moderate consumption of rodents (Jędrzejewska & Jędrzejewski 1998, Sidorovich et al. 2000). Higher consumption of rodents in moraine highlands could be related to established highest abundance of rodents during research in latter study site (Baltrūnaitė 2003). Ungulate carcasses were consumed when other food resources were not available or scarce. In clay plains, carcasses were important in autumn–winter, whereas in sandy plains and moraine highlands this period included also spring. Still, the highest consumption of ungulate carcasses was typical exactly to clay plains. It could be presumed that the great amount of carcasses used in clay plains was a result of abundant ungulates. Due to intensive hunting many ungulates die of wounds, and the predator feeds on their carcasses. In Poland, Bialowieza National Park, ungulate carcasses make the bulk of diet all year round (Jędrzejewska & Jędrzejewski 1998), whereas in Belarus, Finland consumption varies with season (Kauhala 1993b, Sidorovich et al. 2000). Both in Poland and Belarus consumption of carcasses increase in harsh winters with deep snow (Jędrzejewska & Jędrzejewski 1998, Sidorovich et al. 2000). Among other mammals, just hares were more frequent in sandy plains in warm season.

Biomass consumed of birds and amphibians varied with season reaching highest biomass consumed in spring–summer. In many studies increase of these preys consumption is related to warm season (Danilov et al. 1979, Viro & Mikkola 1981, Kauhala 1993b, Jędrzejewska & Jędrzejewski 1998, Sidorovich et al. 2000).

Reptiles were more frequent food item just in spring in clay plains. In other study sites, the same as in many studies, this food was found just occasionally (Danilov et al. 1979, Jędrzejewska & Jędrzejewski 1998, Sidorovich et al. 2000).

Invertebrates (insects, earthworms) were seasonally consumed food both in our and other studies (Danilov et al. 1979, Viro & Mikkola 1981, Kauhala 1993b, Jędrzejewska & Jędrzejewski 1998, Sidorovich et al. 2000). In spring, invertebrates made the bulk of diet in clay plains, whereas in other study sites and most studies this prey type didn˙t reach such high quantities (Kauhala et al. 1998, Sidorovich et al. 2000).

Plants˙ biomass consumed changed depending on season, still, reliable impact was influenced by study site. In sandy plains and moraine highlands, the highest consumption was typical to autumn, still, plants were also important in summer and winter seasons. Meanwhile, in clay plains, plants were frequently used just in summer. Prūsaitė (1960) also notes, that plants are mostly consumed in summer. As all year round important food group, plants are mentioned in Belarus, Finland (Viro & Mikkola 1981, Sidorovich et al. 2000), meanwhile, in Poland, plants are consumed just in moderate amount (Kobylińska 1996, Jędrzejewska & Jędrzejewski 1998). Raccoon dog fed on fruits and berries of common abundant species. In moraine highlands, raccoon dog used mostly pears and apples, which could be found in farmsteads. Meanwhile, in clay plains and sandy plains, both wild (raspberries, bilberries, cranberries) and domestic (apples, plums, cereal) plants were consumed.

Diet seasonality of raccoon dog was related with changes in food abundance and availability. In spring–summer seasons food became more diverse. In spring food was diverse, even though abundance wasn˙t enough (e.g. rodents), meanwhile, in summer both availability and abundance increased. In autumn–winter seasons food spectrum became narrower because of decreased food abundance and availability. Accordingly, food niche breadth also changed seasonally – more diverse food, wider was food niche.

Significant differences were noted to raccoon dog˙s diet in separate study sites. The same food groups were typical for all localities, still, importance and biomass consumed of them differed significantly between sites. Consequently, food niche breadth differed among study sites. It could be supposed that food niche breadth was broadened both by ecosystems with continuous homogeneous pine forest, poor food resources in sandy plains (the lowest ecosystem diversity and fragmentation) and very mosaic and fragmentary habitats with rich food base in moraine highlands (the highest ecosystem diversity and fragmentation). On the one hand, food resources in pine forest were poor and predators couldn˙t feed on one or several food groups because of insufficient food amount. On the other hand, great variety of habitats in small territory provided high diversity of food (both abundant and available) for predators and at the same time high level of fragmentation forced predators to feed on various food – predators used several habitats, where they found different food. Clay plains took intermediate position – both according to food resources and fragmentation. Food was abundant, habitats occupied quite large territory and this enabled predators to specialize in feeding. Every season just one food group made the bulk of raccoon dog˙s diet in clay plains constituting no less than half of biomass consumed. Meanwhile, in sandy plains and moraine highlands consumption of separate food groups didn˙t reach such amounts. Similar situation was observed for red fox (Baltrūnaitė 2003). In clay plains, this predator specializes in hunting for rodents, meanwhile, in sandy plains and moraine highlands, consumption of rodents was significantly lower.

Conclusions

A marked seasonality was typical to raccoon dog˙s diet in Lithuania. Depending on season, ungulate carcasses, rodents, insectivores, birds, amphibians, invertebrates, and plants prevailed in the diet. Seasonal differences of food consumption were related to changes of food abundance and availability in the course of the year. Differences of raccoon dog˙s diet in separate study sites were a result of a different habitat structure of study sites, which in turn determined abundance of food resources. All year round, the broadest food niche was typical to raccoon dog in sandy plains and moraine highlands, the narrowest – in clay plains. More diverse diet was typical to ecosystems with homogenous habitat structure and poor food resources (sandy plains) or in ecosystems with high level of habitat fragmentation and abundant food (moraine highlands).

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FOOD COMPOSITION OF MARSH HARRIER *CIRCUS AERUGINOSUS* DURING AUTUMNAL MIGRATION IN EASTERN POLAND

Ignacy Kitowski

Kitowski I. 2005. Food composition of marsh harrier Circus aeruginosus during autumnal migration in eastern Poland. *Acta Biol. Univ. Daugavp., 5 (1): 85 - 89.*

Food composition of Marsh Harrier *Circus aeruginosus* during autumnal migration was analysed by studying pellets found at communal roost in SE Poland. Common Voles *Microtus arvalis* were found to dominate the food from the autumnal migration period. They constituted 73.1% of 3301g of total prey biomass. Prey of Marsh Harriers included also Root Vole *Microtus oeconomus* and Common Euroasian Spadefood Toad *Pelobates fuscus.* The species together contributed to 12,6% of total prey biomass. Great Green Bush Crickets *Tettigonia viridissima* contributing of 1.19% of 181 prey, with a respective fraction of 0.4% of the total prey biomass, were also found in the autumnal migration food of Harriers. Common Euroasian Spadefood Toad that also have its share in the studied food indicate that the migrating birds could have foraged shortly before sunrise and after the sunset.

Key words: Marsh Harrier, *Circus aeruginosus,* food composition, migration, communal roost, SE Poland

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Introduction

Food composition of Marsh Harrier in Europe has become widely known (Schipper 1973, Underhill – Day 1985, Underhill – Day 1989). The food is usually quite diverse in composition since it contains both actively searched prey and carrion. Marsh Harrier are also known to forage on eggs of different bird species (Schipper 1973, Underhill – 1985, Underhill – Day 1989, Bertolero 2002). Polish major studies on the diet of the concerned raptor were performed by Witkowski (1989) on a breeding population of Marsh Harrier nesting on large fish ponds complex in Milicz (Lower Silesia, SW Poland).

The autumnal migration is a definitely critical period not only for adult individuals, but in particular for juveniles of Marsh Harrier that are to fly over long distance for the first time, having had poor experience in flying and foraging alike (Bustamante 1990). Apart from Witkowski's (1989) research the knowledge of Marsh Harrier food composition beyond the breeding season, i.e. during migration or a wintering period is rather scarce. Therefore, recognising all aspects of migration ecology in Marsh Harrier seems to be of

significant importance and can contribute to at least partial understanding of reasons for such a high rate of the first year mortality occurring in many species of raptors.

Study area and methods

Pellets were collected in the area of Marsh Harriers communal roost near Sitno (50° 452 N, 23°232, SE Poland). The roost was one of the first communal roosts of Marsh Harriers discovered in Poland, and probably also one of the first in Central Europe. The roost harboured the maximum number of 28 Marsh Harriers individuals, adults and first year juveniles that roosted in vegetation of average height of 91 cm (see details in: Kitowski & Pienkosz 2004). Marsh Harriers individuals roosted there exclusively during autumnal migration. The Harriers roosted mainly in Purple Moor Grass *Molinia caerulea*, Reedgrasses *Calamagrostis* spp, and Sedges *Carex* spp., whereas in Nettles *Urtica* spp. and Rushes *Juncus* spp. (Kitowski & Pienkosz 2004, Kitowski I.-unpublished data) they were found to roost quite occasionally. Annual observations at the roost proved no birds present there at the time of spring migration. Pellets were collected at the roosting sites once Marsh Harriers activities at the roost have ceased, i.e. in late September 2003 and 2004. Generally known rules for storing the pellets, their analysis and determining the number of prey were applied. The methods were also based on other papers on diurnal and nocturnal raptors, including Harriers and Owls (Underhill–Day 1985, Ruprecht 1990, Clarke et al. 1993, Bekasinski et al. 1996). However, in field conditions, especially during migration when pellets were collected on the communal roost, differentiating the pellets dropped by adults from the ones dropped by juveniles proved too hard. For that reason a joint analyses for both age classes was performed.

To estimate the vertebrate prey biomass, the data contained in the papers by Juszczyk (1974), J¿ drzejewska & J¿ drzejewski (2001), Pucek (1984) were adapted. As in Kitowski (2000), it was assumed that all Great Green Bush Crickets *Tettigonia viridissima* contributed to 0.7 g of the overall biomass. The breadth of Marsh Harriers food niches was estimated following the formula of Levins (1968) - $B=1/\Sigma p_i^2$, where p_i is proportion of prey category *i* in the total biomass of Marsh Harrier diet.

Results

A total number of 82 pellets was found. From the studied bone material the remnants of n =181 prey were dissected (see: Table 1). Common Voles *Microtus arvalis* have been found to dominate the food of the studied Marsh Harriers. They constituted not only the major part of the overall number of the caught prey but were also the major contribution of the overall biomass (Table 1). Common Voles have been found to dominate among the mammalian prey even heavier, with the respective parameters of number of prey - 84,1%, n =151, biomass of prey - 80.0%, and m = 3015.5 g. In the studied food 11 Common Euroasian Spadefood Toad *Pelobates fuscus* were also found, which gave 6.1% of the overall number n = 181 of all prey and 6.3%, m = 3301.4 g of the total biomass. In the pellets remains of 17 Great Green Bush Crickets *Tettigonia viridissima* were identified. They were observed to have been caught by juveniles migrating for the first time, and adult individuals of Marsh Harrier alike (Kitowski I. -unpublished personal data). The studied Marsh Harriers tend to catch prey of 0.7g - 85 g of mass with a geometrical average of 14.2 ± 9.3g

Discussion

So far no regular, precise and reliable data on Marsh Harrier diet beyond their breeding period in Europe have been performed. Polish direct observations indicated that in the post-fledging period juveniles and adults tend to eat small mammals, insects and carrion (Kitowski I. -unpublished data). Similarly, in Western Europe in the post-fledging period voles and carrion are basic food during migration In Kazahstan birds would catch voles *Microtus* sp. while migrating over

Table 1. Food of Marsh Harrier *Circus aeruginosus* during autumnal migration in SE Poland

Prey	mass	autumn 2003			autumn 2004			Total		
	prey [g]	n_1	$mass_1$ [g]	$\%m_1$	n_2	$mass_2$ [g]	$\%m_2$	N	Mass [g]	%M
Talpa europea	85	1	85	6.1	1	85	4.5	2	170	5.1
Sorex minutus	3.5	-	-	-	1	3.5	0.2	1	3.5	0.1
Microtus oeconomus	26	3	78	5.6	5	130	6.9	8	208	6.3
Microtus arvalis	19	51	969	69.0	76	1444	76.0	127	2413	73.1
Microtus subterraneus	17	2	34	2.4	-	-	-	2	34	1.0
Clethrionomys glareolus	17	-	-	-	2	34	1.8	2	34	1.0
Apodemus agrarius	17	1	17	1.2	-	-	-	1	17	0.5
Apodemus silvaticus	20	2	40	2.8	4	80	4.2	6	120	3.6
Micromys minutus	8	1	8	0.6	1	8	0.4	2	16	0.5
Emberiza calandra	35	1	35	2.5	-	-	-	1	35	1.1
Emberiza citrinella	30	-	-	-	1	30	1.6	1	30	1.0
Pelobates fuscus	19	7	133	9.5	4	76	4.0	11	209	6.3
Tettigonia viridissima	0.7	7	4.9	0.3	10	7	0.4	17	11.9	0.4
Total	-	76	1403.9	100	105	1897.5	100	181	3301.4	100
Levin's B index	-	-	-	2.02	-	-	1.69	-	-	1.83

the stepps (Cramp & Simmons 1980). The only reliable data come from reporting European birds that spend winter time in SW Netherlands. Having analysed the winter pellets from that roost, it was concluded that Marsh Harriers roosting there have specialised in catching ducks - they contributed to about half of their prey numerically and even more importantly by weight (Clarke et al. 1993). Observation on predating on eggs of Yellow-legged Gull *Larus michahellis* during spring migration of Marsh Harriers in Ebro river delta (NE Spain) are also accessible (Bertolero 2002).

The significant role of Voles *Microtus* spp. they played in both years of the study indicates similarities between the migration diet composition and the diet from the breeding period in west Poland (Witkowski 1989) and in Finland (Hilden & Kalinanen 1966). Nevertheless, both in Poland and Finland an important role was played by birds from a water environment. The studied SE Poland Marsh Harriers had a very narrow food niche over the studied period. It resulted from Voles (*Microtus* spp) strongly dominating in the diet, namely contributing to 80.4% of the total biomass of prey. Such a phenomenon can be also observed on nocturnal raptors, where intensive intake of Voles (*Microtus* sp.) causes the food niche to get severely narrow (Marti 1988, Tome 1994). Harriers *Circus* spp., as typical feeding opportunists took such prey that was widely accessible on large, open meadows at which the roost was located. Should any water habitat occur there, Marsh Harriers would most likely catch the animals living there.

Pellets exhibited also Great Green Bush Crickets, which despite a significant numerical rate contributed to a mere fraction of the overall prey biomass. Such prey was caught by adult individuals and juveniles alike. It seems that juveniles and adults on the meadows surrounding the roost, tend to catch large insects more frequently than it was reflected in the found pellets (Kitowski I. -unpublished data and personal observations).

Widely available and easy to catch they constitute a substantial prey for the migrating for the first time juveniles, though small mammals, Voles in particular, are much more valuable energetically. Hunting grasshoppers by young Marsh Harriers during migration makes them perfect their hunting capabilities. Moreover, it has been proved in other raptors that easy to catch and widely available insects tend to be caught by adult raptors in selected seasons of the year. They also provide the basic prey for birds of poor hunting experience such as juveniles or immature individuals (Toland 1986, Varland et al.

1991).

Juveniles, and particularly adults, could caught another relatively easy to catch prey, namely common Euroasian Spadefood Toads *Pelobates fuscus*. It is closely related to the observed incidental cases of foraging within the communal roost by birds that arrived there hungry (empty crops) or very late after sunset (Kitowski I.- unpublished data). It confirmed impermanent foraging tendencies observed on communal roosts of Hen Harriers *Circus cyaneus* and Montagu?s Harriers *Circus pygargus* where foraging sessions took place just after sunset and are performed by individuals arriving very late on the roost area (Clarke & Watson 1990, Kitowski 2004a,b). Such behavioural tactics makes it possible for Harriers to catch amphibians exhibiting nocturnal activity prior to definite dropping on vegetation for roosting. Common Euroasian Spadefood Toads can be also caught in the direct proximity of the roost at daybreak upon its leaving. Catching Common Euroasian Spadefood Toads provides a perfect example of an optimised energy intake over a very limited time that can be spent on foraging by migrating Harriers. Individuals which did not manage to consume enough prey during the day are particularly prone to such behaviour. Species of birds such as corn buntings *Emberiza calandra* and Yellowhammers *Emberiza citrinella*, as well as mammals such as *Microtus subterraneus*, confirm Marsh Harrier foraging preferences to hunt at open, poorly covered with bush areas, which had been reported earlier by other researchers (Schipper 1973, Schipper 1977).

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NOTIOPHILUS KATRINAE SP. N. (COLEOPTERA: CARABIDAE) – NEW SPECIES FROM CHINA

Arvīds Barševskis

Barševskis A. 2005. *Notiophilus katrinae* sp. n. (Coleoptera: Carabidae) – new species from China. *Acta Biol. Univ. Daugavp., 5 (1): 91 - 94.*

A new species of genus *Notiophilus* Dum. from China has been described in the article, which has been collected in the Northern part of Sichuan. The species has been described after the series of four samples. The description has been illustrated with ... pictures.
There is given the comparison of the species with the other species of this genus, which can be traced in China.

Key words: *Notiophilus*, new species, Carabidae, China, Sichuan

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Introduction

The fauna of the genus *Notiophilus* Dumeril, 1806 (Coleoptera: Carabidae) is incompletely investigated in China. The descriptions of various new species in recent years (Barševskis 2003, 2004) is indicative of it.

While processing the representatives from China, which are in author's collection, one new species was determined, which was collected in N Sichuan. The description of the new species is given further.

At the present 11 species, including the new one, of the genus *Notiophilus* Dum. are found in China (Bousquet, Barševskis 2003; Barševskis 2003,2004).

The pictures used for illustrating the description are made by Zeiss stereomicroscope *Zeiss SteREO Lumar V12* and *Axiocam* digital camera. The pictures have been processed and the morphometrical measurements were taken by *Axioview 4.4* software.

The measurements of the body (including episterna) were taken according to the methodology used in the morphological researches of this genus (Dostal, 1986; Schmidt, Hartmann 2001).

The research has been carried out due to research grant financing from European Regional Development Fund, Latvian Science Council and Daugavpils University.

Notiophilus katrinae sp. nov.

Holotype (Fig. 1.). Male. China: N Sichuan, Pass. between Songpan and Juijaigow, 4000 m., 10. – 15.07.2005., V.Patrikeev leg.- ABC

Paratypes (Figs. 2 -4). 2 Males (A - B), 1 Female (C). China: N Sichuan, Pass. between Songpan and Juijaigow, 4000 m., 10. – 15.07.2005., V.Patrikeev leg. - ABC

Holotype and paratypes are kept in author's collection (abbrev. - ABC) in Daugavpils, Latvia.

General description. Body is black and glossy. The upper part and part of head at the bottom are colour of bronze and glossy. The frons with six frontal furrows approximated at the bottom. Elytra with one dorsal pore, but at the apex with two apical pores. The second interval of the elytra is very wide, approximately of the same width as the remaining 4 taken together. The legs are red-

Fig. 1. Holotype

Fig. 2. Paratype A (male)

Fig. 3. Paratype B (male)

Fig. 4. Paratype C (female)

yellow coloured, with darker tarsus and hind femora. The anal sternite of male has one or two setiferous pores (other known species of this genus has one setiferous pore), but the female has two pores, at least outer of which lies in a long impression parallel to the side.

Morpfometrics. Length of body 4.7 – 5.2 mm. Width of head together with eyes 1.4 -1.6 mm; width of pronotum 1.4 - 1.6 mm; width of elytra 1.6 – 1.8 mm. Length of elytra 2.7 - 3.0 mm; length of pronotum on sides 0.8 - 1.0 mm. Correlation between the approximate width of head, pronotum and elytra 1.5:1.5:1.7. the correlation between length and width of episterna is 2:1.

Fig. 5. Head of Holotype.

Head (Fig. 5.). The head is black, at the upper part and round the eyes it has a strong gloss of the bronze colour. Between eyes 6 frontal furrows, which are approximated at the bottom, strongly impressed, but in the front side of the eyes it rises up like a roof and then sharply bends in the direction of clypeus. Labrum has rounded front side. Antenna are dark with 4 russet basal antennomeres. Palpes are dark with russet basal antennomeres.

Thorax. Prontum is of the same width as head. Sides are S-shaped and curved. Their maximum width is at the front. The dorsal disc is smooth and glossy with thin, fine and dissipated dots and rare almoust indiscentible folds, especially along the pressed central line. Along the sides it is roughly dotted and covered with microsculpture. The basal angles are stumpy and wide. At the bottom thorax is roughly dotted. Episterns are short. Their length is only two time bigger than width. The legs are red-yellow coloured, with darker tarsus and hind femora.

Elytra. The second interval is wide, approximately of the same width as the remaining 4 taken together. The first and second intervals and side intervals are smooth, but the third till seventh intervals have marked reticulate microsculpture. The dorsal pore lies in the fourth interval, in the

Fig. 6. Lamella of *aedeagus* (Paratype A).

Fig. 7. *Aedeagus* (Paratype A).

basic third of elytra. It has two apical pores. The apex has rough microsculpture and it is mat. Dorsal elytral strias beginning with the third one are roughly dotted, strongly impressed at the base part and well marked till the apex. The sutural stria also reaches the apex. The fourth till sixth strias are very approximated. There are some rough out-pressed fosette-like dots near the scutellum.

Abdomen. The anal sternit of male has one or two pores, but the one of female has two pores, at least outer of which lies in a long impression parallel to the side. The other abdomen sternites at sides are smooth and glossy and have small folds.

Genitalia. *Aedeagus* curved (see picture ...). Lamella's end is bent down a little. Paramera are wide, shorter than *aedeagus*.

Differential diagnosis. *N. katrinae* sp. n. differs from other species of the genus *Notiophilus* Dum. with a complex of characteristics: red-yellow legs, layout of dots and microsculpture of the elytra, deep and long impression along the side of anal sternite, in which lies the outer setiferous pore, shape of pronotum a.o. characteristics. It differs from the species *N. spaethi* Reitt. found in Tian Shan mountains (territory of China), which also has red-yellow legs, with a different shape of pronotum, layout of dots on elytra, shape of body a.o. characteristics.

Distribution. China, North Sichuan.

Derivation of name. The new species has been named in honour of my daughter Katrīna Barševska. The name of the species has been made from the daughter's name Katrīna *(katrinae)*.

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