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THE BIG-HEADED FLIES (DIPTERA: PIPUNCULIDAE) OF THE KRKONOŠE MTS.

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Abstract: Extensive faunistic research of the Krkonoše Mts. performed in 2005-2009 resulted in extending the list of Pipunculidae recorded so far from this area to 44 species. *Chalarus juliae* Jervis, 1992 is reported for the first time from the Czech Republic. *Chalarus indistinctus* Jervis, 1992, *Nephrocerus flavicornis* Zetterstedt, 1844 and *Dorylomorpha rufipes* (Meigen, 1824) are first findings for the territory of Bohemia. Faunistics, level of dominance, and hypsometry are discussed.

Key words: Diptera, Pipunculidae, Krkonoše Mts., faunistics, hypsometry

INTRODUCTION

Krkonoše Mts. are the highest mountain range and one of the most important areas for geobiodiversity in the Czech Republic. Tertiary orogeny, subsequent water erosion and recurrent Quaternary glaciations gradually transformed the natural appearance of Krkonoše Mts. into its current form. The existence of arctic-alpine tundra makes the mountains a unique, isolated place of the northern and alpine type in the middle of Europe. The communities of vascular plants contain over 1,200 taxa, of which about two thirds are native to the mountains. The fauna of different groups of invertebrates was studied for decades, it results in reporting of more than 15,000 species from Krkonoše Mts.

The team of dipterologists from Agricultural University in Prague accomplished extensive sampling at numerous collecting sites in Krkonoše Mts. It resulted in the accumulation of large material including big-headed flies. The larvae of these tiny insects are almost exclusively endoparasitoids of Auchenorrhyncha with the only exception of genus *Nephrocerus* larvae of which are developing in adult crane flies (Tipulidae) (KOZÁNEK et al. 1998). Over 1,400 species were described worldwide. European Pipunculidae fauna comprises of 209 species, 112 of them are known from the Czech Republic. So far, only three species of big-headed flies were recorded from the Krkonoše Mts.

MATERIAL AND METHODS

The material of Pipunculidae included in this study was obtained in a frame of an extensive faunistic research program focused on the dipteran communities of Krkonoše Mts. in the period of years 2005-2009. All specimens were collected by M. Barták and J. Vaněk using Malaise traps (MT) or yellow pitfall traps (PT). These collecting methods were completed by sweeping (M. Barták). The material was stored in 70% ethanol and subsequently dry mounted. The following identification keys were used: ALBRECHT (1990), DE MEYER (1989), FÖLDVÁRI & DE MEYER (1999), GROOTAERT & DE MEYER (1986), JERVIS (1992), KEHLMAIER (2005, 2006, 2008a). All material is deposited in the collections of M. Barták and M. Kozánek. For the dominant groups, we used the scale proposed by TISCHLER (1949) and completed by HEYDEMANN (1955).

Kruskal-Wallis non-parametric ANOVA was used to determine the significances between abundance values due to the fact, that the data were not normally distributed, according to the Shapiro-Wilk W-test ($p_{crit.} < 0.05$).

The similarity of the species assemblages at selected localities of actual altitudes was evaluated by cluster analysis. Localities with less than five individuals were excluded. The similarity in the hypsometric distribution was evaluated by cluster analysis as well. Altogether, twenty two most abundant species were evaluated; the species represented by less than three individuals were excluded. In both cases was used neighbour-joining clustering (Euclidean similarity index, Outgoup root) using updated PAST 3 system package (HAMMER et al. 2001).

DCA ordination method (joint diagram) was used to express the relationship of pipunculid species to the altitude. The species represented by less than three individuals were excluded in this analysis as well.

Collecting sites

BDM – Bíner, damp meadow, 50°37'50.1"N 14°40'34.3"E, 609 m
DPB – Dvorský potok env., 50°45'54"N 15°34'41"E, 1120 m
LRB – Labská rokle, nr. Labská bouda, 50°46'19"N 15°32'43"E, 1300 m
LDR – Labský důl, nr. Labe river, 50°44'08"N 15°43'32"E, 1040 m
LHE – Liščí hora env., 50°41'17"N 15°39'10"E, 1050-1150 m
LBB – Luční Bouda, nr. Bílé Labe, 50°44'19"N 15°40'38"E, 1250 m
MFL – Medvědín, upper forest line, 50°44'41.8"N 15°33'59.5"E, 1300 m
ODB – Obří důl, nr. brook, 50°43'36"N 15°43'40"E, 950 m
ODP – Obří důl, nr. pond, 50°43'36"N 15°43'40"E, 950 m
PDP – Pančava, dwarf pine + peat bog, 50°46'15.8"N 15°32'19.0"E, 1300 m
PPB – Pekelský potok env., 50°38'13.3"N 14°40'29.3"E, 550 m
PPD – Pekelský potok, damp valley, 50°38'13.3"N 14°40'29.3"E, 550 m
SSP – Slunečná stráň, nr. pond, 50°38'12.5"N 14°49'23.6"E, 645 m

SSS – Slunečná stráň, nr. Svoboda n. Ústím, 50°38'12.5"N 14°49'23.6"E, 645 m
SSM – Slunečná stráň, meadow, 50°38'12.5"N 14°49'23.6"E, 645 m
UDP – U bufetu, dwarf pines, 50°42'32.5"N 15°40'25.1"E, 1370 m
UPB – Úpa, peat bog, 50°44'14"N 15°42'55"E, 1407 m
UJO – Úpská jáma, Obří důl, 50°44'08"N 15°43'32"E, 1100 m
VBF – V bažinkách, forest, 50°43'59.6"N 15°38'30"E, 850 m
VKJ – Velká kotelní jáma, 50°44'56.7"N 15°32'18.2"E, 1120 m
ZPB – Zrcadlový potok, nr. brook, 50°38'1.9"N 14°43'54.6"E, 670 m

RESULTS

Faunistics

Altogether, 338 representatives of family Pipunculidae collected within extensive dipterological research of Krkonoše Mts. which was accomplished at 21 collecting sites in 2005-2009 were included in this study. Among them, 321 specimens were identified at species level. The material contained 42 pipunculid species belonging to 10 genera. *Chalarus juliae* Jervis, 1992 is reported for the first time from the Czech Republic. *Chalarus indistinctus* Jervis, 1992, *Nephrocerus flavicornis* Zetterstedt, 1844 and *Dorylomorpha rufipes* (Meigen, 1824) are first findings for the territory of Bohemia. Current check-list of Pipunculidae of Krkonoše Mts. includes 44 species.

Species list and collecting data

The abbreviations of collecting sites are listed in Material and methods. The number in brackets behind the species name represents the ratio of male/female individuals of the species).

1. *Chalarus argenteus* Coe, 1966 (0/1)
   BDM, 7.vii.-4.viii.2009, 1f. Hypsometric range: 609 m.
2. *Chalarus basalis* Loew, 1873 (0/2)
   BDM, 7.vii.-4.viii.2009, 1f, ZPB, 18.viii.-1.ix.2009, 1f. Hypsometric range: 609-670 m.
3. *Chalarus indistinctus* Jervis, 1992 (0/1)
   VKJ, 6.-26.vi.2008, 1f. Hypsometric range: 1120 m.
4. *Chalarus juliae* Jervis, 1992 (0/1)
   LBB, 2.-9.viii.2007, 1f. Hypsometric range: 1250 m.
5. *Chalarus pughi* Coe, 1966 (0/3)
   BDM, 4.-31.viii.2009, 1f, SSP, 2.-30.vi.2009, 1f, VBF, 17.vi.-13.viii.2005, 1f. Hypsometric range: 609-850 m.
6. *Chalarus spurius* (Fallén, 1818) (0/8)
   PPB, 7.v.-4.vi.2009, 2f, 30.vi.-30.vii.2009, 1f, 18.vii.-31.viii.2009, 1f, BDM, 7.vii.-4.viii.2009, 2f, SSP, 30.vi.-4.viii.2009, 1f, ZPB, 2.-30.vi.2009, 1f. Hypsometric range: 550-670 m.

7. *Jassidophaga pilosa* (Zetterstedt, 1838) (0/5)
BDM, 7.vii.-4.viii.2009, 1f, ZPB, 7.v.-2.vi.2009, 1f, LDR, 28.vi.-7.vii.2006, 1f, LBB, 25.-31.v.2007, 1f, 7.-14.vi.2007, 1f. Hypsometric range: 609-1250 m.
8. *Jassidophaga villosa* (von Roser, 1840) (1/1)
ZPB, 2.-30.vi.2009, 1f, VKJ, 26.vi.-8.vii.2008, 1m. Hypsometric range: 670-1120 m.
9. *Verrallia aucta* (Fallén, 1817) (1/3)
BDM, 16.vi.-7.vii.2009, 1f, 7.vii.-4.viii.2009, 1f, LHE, 3.-4.vi.2005, 1m, 1f. Hypsometric range: 609-1120 m.
10. *Nephrocerus flavicornis* Zetterstedt, 1844 (0/1)
PPB, 7.v.-4.vi.2009, 1f. Hypsometric range: 550 m.
11. *Nephrocerus lapponicus* Zetterstedt, 1838 (6/18)
PPB, 7.v.-4.vi.2009, 13f, SSP, 7.v.-2.vi.2008, 1m, 1f, VKJ, 6.-26.vi.2008, 3m, 26.vi.-8.vii.2008, 2m, ZPB, 7.v.-2.vi.2008, 4f. Hypsometric range: 550-1120 m.
12. *Nephrocerus scutellatus* (Macquart, 1834) (0/4)
PPD, 4.-30.vi.2009, 2f, SSP, 2.-30.vi.2009, 1f, ZPB, 2.-30.vi.2009, 1f. Hypsometric range: 550-670 m.
13. *Cephalops* (*Cephalops*) *aeneus* Fallén, 1810 (0/3)
BDM, 31.viii.-13.x.2009, 1f, ZPB, 30.vi.-4.viii.2009, 1f, LDR, 4.-29.viii.2006, 1f. Hypsometric range: 609-670 m.
14. *Cephalops* (*Cephalops*) *vittipes* (Zetterstedt, 1844) (12/22)
PPB, 7.v.-4.vi.2009, 1f, BDM, 21.v.-16.vi.2009, 3m, 1f, 16.6.-7.vii.2009, 1m, 4f, SSP, 7.v.-2.vi.2009, 6m, 4f, 2.-30.vi.2009, 1m, 3f, ZPB, 2.-30.vi.2009, 1m, 5f,7.v.-2.vi.2009, 2f, 30.vi.-4.viii.2009, 1f, VKJ, 6.-26.vi.2008, 1f. Hypsometric range: 550-1120 m.
15. *Cephalops* (*Parabeckerias*) *obtusinervis* (Zetterstedt, 1844) (4/8)
BDM, 21.v.-16.vi.2009, 1m, SSP, 7.v.-2.vi.2009, 2f, ZPB, 2.-30.vi.2009, 1f, LDR, 15.-21.vi.2008, 2m, 2f, VKJ, 6.-26.vi.2008, 1m, 4f. Hypsometric range: 609-1250 m.
16. *Cephalops* (*Semicephalops*) *carinatus* (Verrall, 1901) (1/2)
SSS, 30.vi.-4.viii.2009, 1m, 1f, SSP, 4.viii.-1.x.2009, 1f. Hypsometric range: 645 m.
17. *Cephalops* (*Semicephalops*) *subultimus* Collin, 1956 (3/3)
BDM, 4.-31.viii.2009, 1f, SSS, 30.vi.-4.viii.2009, 3m, ZPB, 30.vi.-4.viii.2009, 2f. Hypsometric range: 609-670 m.
18. *Cephalops* (*Semicephalops*) *ultimus* (Becker, 1900) (3/2)
PPB, 31.viii.-13.x.2009, 1m, BDM, 21.v.-16.vi.2009, 1m, SSS, 30.vi.-4.viii.2009, 1f, VKJ, 6.-26.vi.2008, 1m, ZPB, 18.viii.-1.ix.2009, 1f. Hypsometric range: 550-1120 m.
19. *Cephalops* (*Semicephalops*) *varipes* (Meigen, 1824)
(= *Cephalops semifumosus* Kowarz, 1887) (2/9)
BDM, 31.viii.-13.x.2009, 2m, 7.vii.-4.viii.2009, 2f, 4.-31.viii.2009, 3f, SSS, 30.vi.-4.viii.2009, 1f, ZPB, 18.viii.-1.ix.2009, 2f, VKJ, 29.viii.-1.x.2008, 1f. Hypsometric range: 609-1120 m.
20. *Eudorylas carpathicus* Kozánek, 1993 (1/0)
ZPB, 30.vi.-4.viii.2009, 1m. Hypsometric range: 670 m.
21. *Eudorylas elephas* (Becker, 1897) (1/0)
PPB, 30.vi.-30.vii.2009, 1m. Hypsometric range: 550 m.

22. *Eudorylas furvulus* Collin, 1956 (0/3)
BDM, 31.viii.-13.x.2009, 1f, SSP, ix.2008, 1f, UJO, 14.viii.-19.ix.2007, 1f. Hypsometric range: 609-1100 m.
23. *Eudorylas fuscipes* (Zetterstedt, 1844) (0/1)
SSP, vii.2008, 1f. Hypsometric range: 645 m.
24. *Eudorylas montium* (Becker, 1897) (3/2)
BDM, 21.v.-16.vi.2009, 1m, 7.vii.-4.viii.2009, 2m, 1f, ZPB, 30.vi.-4.viii.2009, 1f. Hypsometric range: 609-670 m.
25. *Eudorylas obliquus* Coe, 1966 (2/0)
BDM, 31.viii.-13.x.2009, 1m, SSP, 7.v.-2.vi.2009, 1m. Hypsometric range: 609-645 m.
26. *Eudorylas subfascipes* Collin, 1956 (7/8)
PPB, 7.v.-4.vi.2009, 2f, SSP, 7.v.-4.vi.2009, 4m, 2f, ZPB, 7.v.-4.vi.2009, 3m, 4f. Hypsometric range: 550-670 m.
27. *Eudolylas subterminalis* Collin, 1956 (3/1)
BDM, 7.vii.-4.viii.2009, 1m, 1f, SSP, 7.v.-2.vi.2009, 1m, ZPB, 7.v.-2.vi.2009, 1m. Hypsometric range: 609 - 670 m. Hypsometric range: 609-670 m.
28. *Eudorylas zonellus* Collin, 1956 (2/3)
BDM, 16.vi.-7.vii.2009, 2m, 1f, 7.vii.-4.viii.2009, 2f. Hypsometric range: 609 m.
29. *Microcephalops opacus* (Fallén, 1818) (= *Microcephalops vestitus* Becker, 1900) (3/0)
BDM, 31.viii.-13.x.2009, 2m, SSP, 30.vi.-4.viii.2009, 1m. Hypsometric range: 609-645 m.
30. *Pipunculus campestris* Latreille, 1804 (6/4)
BDM, 21.v.-16.vi.2009, 1m, 31.viii.-13.x.2009, 1m, 7.vii.-4.viii.2009, 2f, SSP, 4.viii.-1.x.2009, 3m, SSS, 30.vi.-4.viii.2009, 1m, SSM, vii.2008, 1f, UPB, 12.-19.vii.2007, 1f. Hypsometric range: 609-1407 m.
31. *Pipunculus lenis* Kuznetzov, 1991 (= *Pipunculus thomsoni* Becker, 1897) (7/6)
BDM, 16.vi.-7.vii.2009,4m, 2f, 7.vii.-4.viii.2009, 3m, 2f, ZPB, 30.vi.-4.viii.2009 1f, LDR, 13.-20.vii.2008, 1f. Hypsometric range: 609-1040 m.
32. *Pipunculus tenuirostris* Kozánek, 1981 (6/16)
BDM, 16.vi.-7.vii.2009, 2m, 7.vii.-4.viii.2010, 2m, 6f, SSS, 30.vi.-4.viii.2009, 1m, 6f, SSP, 4.viii.-1.x.2009, 1m, 2.-30.vi.2009, 1f, ZPB, 30.vi.-4.viii.2009, 1f, LDR, 24.-27.vii.2006, 1f, VKJ, 30.vi.-13.viii.2008, 1f. Hypsometric range: 609-1120 m.
33. *Pipunculus violovitshi* Kuznetzov, 1991 (= *Pipunculus varipes* Meigen, 1824) (3/7)
SSP, 2.-30.vi.2009, 1m, SSS, 30.vi.-4.viii.2009, 1m, 3f, ZPB, 30.vi.-4.viii.2009, 1m, 2f, LDR, 28.vi.-7.vii.2006, 1f, UJO, 5.vi.-10.vii.2007, 1f. Hypsometric range: 645-1100 m.
34. *Pipunculus wolfi* Kowarz, 1887 (0/2)
SSP, 4.viii.-1.x.2009, 1f, UJO, 5.vi.-10.vii.2007, 1f. Hypsometric range: 645-1100 m.
35. *Tomosvaryella sylvatica* (Meigen, 1824) (17/7)
BDM, 7.vii.-4.viii.2009, 1m, 1f, UJO, 5.vi.-10.vii.2007, 9m, 10.vii.-14.viii.2007, 3m, VKJ, 26.vi.-8.vii.2008, 3m, 30.vii.-13.viii.2008, 1m, 6.-26.vi.2008, 3f, LBB, 7.-14.vi.2007, 2f, DPB, 7.vii.-7.viii.2006, 1f. Hypsometric range: 609-1250 m.
36. *Dorylomorpha* (*Dorylomorpha*) *confusa* (Verrall, 1901) (6/5)
SSP, 2.-30.vi.2009, 1m, UJO, 5.vi.-10.vii.2007, 1m, 4f, VKJ, 6.-26.vi.2008, 1m, 1f, DPB, 15.vi.-7.vii.2006, 1m, 7.vii.-7.viii.2006, 2m. Hypsometric range: 645-1120 m.

37. *Dorylomorpha* (*Dorylomorpha*) *extricata* (Collin, 1937) (1/4)
ZPB, 7.v.-2.vi.2009, 1m, 4f. Hypsometric range: 670 m.
38. *Dorylomorpha* (*Dorylomorpha*) *rufipes* (Meigen, 1824) (0/2)
SSP, 2.-30.vi.2009, 2f. Hypsometric range: 645 m.
39. *Dorylomorpha* (*Dorylomyia*) *xanthocera* (Kowarz, 1887) (18/16)
BDM, 21.v.-16.vi.2009, 1f, SSP, 21.-28.vi.2006, 1m, SSS, 30.vi.-4.viii.2009, 2f, ODP, 21.-28.vi.2006, 1m, ODB, 2.viii.2007, 1f, LDR, 28.vi.-7.vii.2006, 2m, 2f, 7.-13.vii.2006, 4m, 3f, 13.-20.vii.2008, 2m, 1f, 24.-27.vii.2006, 1m, 21.-28.vi.2006, 2f, VKJ, 6.-26.vi.2008, 2m, 26.vi.-8.vii.2008, 2f, LRB, 19.vi.-7.vii.2006, 1f, LHE, 29.vi.-26.vii.2005, 1m, DPB, 7.vi.-7.vii.2006, 2m, 15.vi.-7.vii.2006, 2m, 1f. Hypsometric range: 609-1300 m.
40. *Dorylomorpha* (*Dorylomyza*) *albitarsis* (Zetterstedt, 1844) (12/10)
LDR, 28.vi.-7.vii.2006, 1m, 21.-28.vi.2006, 1m, 1f, UJO, 5.vi.-10.vii.2007, 4f, VKJ, 26.vi.-8.vii.2008, 2m, 6.-26.vi.2008, 2m, 1f, LBB, 14.-21.vi.2007, 1m, UDP, 22.vi.-26.vii.2005, 1m, MFL, 24.vi.-27.vii.2005, 1m, 3f, DPB, 15.vi.-7.vii.2006, 1m, 1f, 7.vii.-7.viii.2006, 2m. Hypsometric range: 1040-1300 m.
41. *Dorylomorpha* (*Dorylomyza*) *xanthopus* (Thomson, 1870) (0/1)
PDP, 10.-24.vi.2005, 1f. Hypsometric range: 1300 m.
42. *Dorylomorpha* (*Pipunculina*) *maculata* (Walker, 1834) (0/1)
BDM, 4.-31.viii.2009, 1f. Hypsometric range: 609 m.

Faunistically interesting findings

Chalarus indistinctus Jervis, 1992
European species reported from Belgium, Czech Republic (Moravia), Denmark, Finland, France, Germany, Great Britain, Hungary, Slovakia, Spain, Sweden, Switzerland and the Netherlands. The first finding from Bohemia.

Chalarus juliae Jervis, 1992
More recently described species, so far mentioned from Finland, France, Germany, Great Britain, Near East, European Russia, Slovakia, Spain, Sweden and Switzerland. The first finding from the Czech Republic.

Nephrocerus flavicornis Zetterstedt, 1844
European species so far recorded from Austria, Belgium, Czech Republic (Moravia), Denmark, Finland, France, Germany, Great Britain, Hungary, Latvia, Poland, Slovakia, Sweden, Switzerland and the Netherlands. The first finding from Bohemia.

Eudorylas carpathicus Kozánek, 1993
Species more recently described from Ukraine Carpathians (Jasenje), so far recorded from the Czech Republic (Bohemia), Italy, Slovakia and Ukraine. Specimens mentioned from Czech Republic were collected at Jizerské hory (Rašeliniště Jizery NR) at 870 m by Malaise trap located at Sphagnetum-picetum with scarce *Picea* (Kehlmayer, 2005). The second finding from the Czech Republic.

Pipunculus wolfi Kowarz, 1887
The species was described from a male and female taken in copula in Mariánské Lázně (Marienbad) and later on synonymized by Strobl (1894) with *P. campestris.* Kehlmaier (2008a) studied type material and revealed that *P. wolfi* is valid species. Specimens included in this study represents therefore, the second finding of this species from the Czech Republic.

Dorylomorpha rufipes (Meigen, 1824)
Species with Central and North European distribution. In the Czech Republic, it is known from several Moravian localities. The first finding from Bohemia.

The checklist of Pipunculidae of the Krkonoše Mts.

CHALARINAE Aczél, 1939
- *Chalarus* Walker, 1834
  - *argenteus* Coe, 1966
  - *basalis* Loew, 1873
  - *indistinctus* Jervis, 1992
  - *juliae* Jervis, 1992
  - *pughi* Coe, 1966
  - *spurius* (Fallén, 1818)
- *Jassidophaga* Aczél, 1934
  - *pilosa* (Zetterstedt, 1838)
  - *villosa* (von Roser, 1840)
- *Verrallia* Mik, 1899
  - *aucta* (Fallén, 1817)

NEPHROCERINAE Aczél, 1939
- *Nephrocerus* Zetterstedt, 1844
  - *flavicornis* Zetterstedt, 1844
  - *lapponicus* Zetterstedt, 1838
  - *scutellatus* (Macquart, 1834)

PIPUNCULINAE Walker, 1834
Cephalopsini Macquart, 1834
- *Cephalops* Fallén, 1810
- <u>sg. *Cephalops*</u> Fallén, 1810
  - *aeneus* Fallén, 1810
  - *vittipes* (Zetterstedt, 1844)
- <u>sg. *Parabeckerias*</u> De Meyer, 1994
  - *obtusinervis* (Zetterstedt, 1844)
- <u>sg. *Semicephalops*</u> De Meyer, 1994
  - *carinatus* (Verrall, 1901)
  - *subultimus* Collin, 1956
  - *ultimus* (Becker, 1900)
  - *varipes* (Meigen, 1824) (= *semifumosus* Kowarz, 1887)

Eudorylini Rafael & De Meyer, 1992
- *Clistoabdominalis* Skevington, 2001
  - *electus* (Hardy, 1947) Reported from Krkonoše Mts. by Duda 1940

Eudorylas Aczél, 1940
carpathicus Kozánek, 1993
elephas (Becker, 1897)
furvulus Collin, 1956
fuscipes (Zetterstedt, 1844)
montium (Becker, 1897)
obliquus Coe, 1966
subfascipes Collin, 1956
subterminalis Collin, 1956
zonellus Collin, 1956

Microcephalopsini Rafael & De Meyer, 1991
Microcephalops De Meyer, 1989
opacus (Fallén, 1818) (= *vestitus* Becker, 1900)

Pipunculini Walker, 1834
Pipunculus Latreille, 1802
campestris Latreille, 1802
lenis Kuznetzov, 1991 (= *thomsoni* Becker, 1897)
tenuirostris Kozánek, 1981
violovitshi Kuznetzov, 1991 (= *varipes* Meigen, 1824)
wolfi Kowarz, 1887

Tomosvaryellini Hardy, 1943
Tomosvaryella Aczél, 1939
sylvatica (Meigen, 1824)
Dorylomorpha Azcél, 1939
sg.*Dorylomorpha* Aczél, 1939
confusa (Verrall, 1901) Reported from Krkonoše Mts. by Lauterer 1981
extricata (Collin, 1937)
rufipes (Meigen, 1824)
sg. *Dorylomyia* Albrecht, 1990
incognita (Verrall, 1901) Reported from Krkonoše Mts. by Lauterer 1981
xanthocera (Kowarz, 1887)
sg.*Dorylomyza* Albrecht, 1990
albitarsis (Zetterstedt, 1844)
xanthopus (Thomson, 1870)
sg. *Pipunculina* Albrecht, 1990
maculata (Walker, 1834)

Dominance level

The species rate directly correlated with a number of collected pipunculids in four evaluated localities. The highest species rate and number were recorded at BDM – 22/62, following by SSP – 20/44, ZPB – 16/28 and VKJ – 12/28. *C. vittipes* and *E. subfacipes* were eudominant at more than one locality. The altitude of the localities where these species were eudominant does not exceed 1000 m asl. *N. lapponicus, N. scutellatus, C. obtusinervis, P. lenis, P. tenuirostris* and *D. albitarsis* were eudominant at one locality. *N. lapponicus, C. obtusinervis* and *D. albitarsis* were eudominant species at the locality with the altitude higher than 1000 m asl (Tab. 1).

Table 1. The number and dominance level (DL) of pipunculid species at four localities of Krkonoše Mts. (BDM – Bíner, damp meadow, SSP – Sluneční stráň, nr. pond, ZPB – Zrcadlový potok, nr. brook, VKJ – Velká kotelní jáma).

Species	**BDM**	**DL**	**SSP**	**DL**	**ZPB**	**DL**	**VKJ**	**DL**
Ch. argenteus	1	R						
Ch. basalis	1	R			1	SD		
Ch. indistinctus							1	SD
Ch. pughi	1	R	1	SD				
Ch. spurius	2	SD	1	SD	1	SD		
J. pilosa	1	R			1	SD		
J. villosa							1	SD
V. aucta	4	D						
N. lapponicus			2	SD			5	EU
N. scutellatus			1	SD	3	EU		
C. aeneus	1	R			1	SD		
C. carinatus			1	SD				
C. obtusinervis	1	R	2	SD	1	SD	4	EU
C. subultimus	1	R			2	D		
C. ultimus	1	R					1	SD
C. varipes					1	SD	1	SD
C. vittipes	8	EU	14	EU	4	EU	1	SD
E. carpathicus					1	SD		
E. furvulus	1	R	1	SD				
E. fuscipes			1	SD				
E. montium	4	D			1	SD		
E. obliquus	1	R	1	SD				
E. subfascipes			6	EU	6	EU		
E. subterminalis	2	SD	1	SD	1	SD		
E. zonellus								
M. opacus	2	SD	1	SD				
P. campestris	4	D	3	D				
P. lenis	11	EU			1	SD		
P. tenuirostris	10	EU	2	SD	1	SD	1	SD
P. violovitshi			1	SD	2	D		
P. wolfi			1	SD				
T. sylvatica	2	SD					2	D
D. albitarsis							5	EU
D. confusa			1	SD			2	D
D. extricata								
D. maculata	1	R						
D. rufipes			2	SD				
D. xanthocera	2	SD	1	SD			4	
Total	**62**		**44**		**28**		**28**	

Hypsometric distribution

Kruskal-Wallis test of pipunculid mean abundance confirmed the significant influence of altitude ($p<0.0001$). The collecting sites can be divided based on the cluster analysis to two groups depending on their altitude (Fig. 1). The first group represents sites with altitude up to 1000 m asl (above sea level) ranging from 550 m to 950 m asl. The second group is formed by collecting sites with elevation over 1000 m which were located in the range between 1040 m to 1407 m asl.

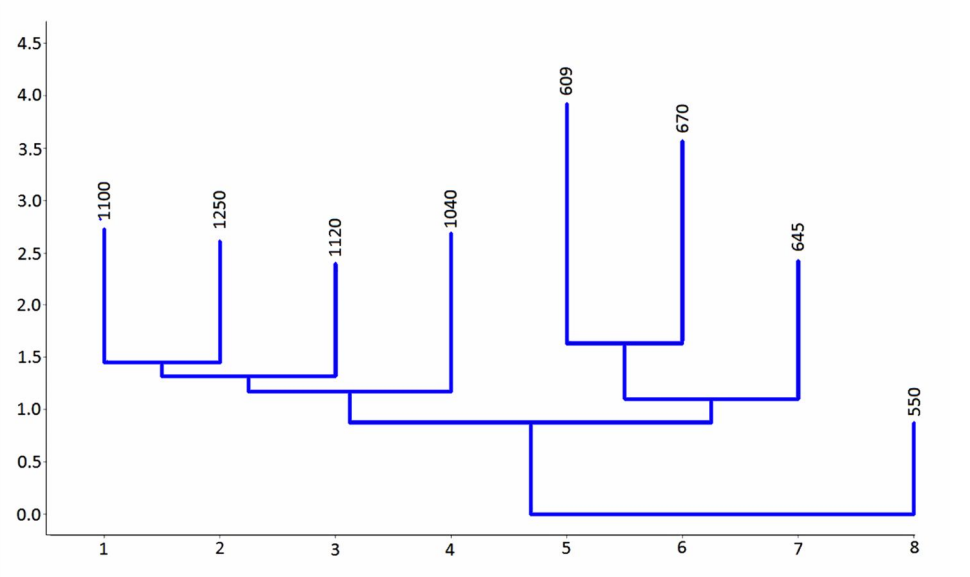

Fig. 1. The similarity of pipunculid communities of selected collecting sites expressed in their altitude.

Altogether, 36 species were recorded at collecting sites located at the altitude below 1000 m asl and 22 species at sites at the altitude higher than 1000 m asl (Tab. 2). The highest species number (35 species) was found at collecting sites of the altitude range from 609 m to 670 m asl. It represents 83 % of all recorded species. On the contrary, the maximum species diversity at collecting sites located above 1000 m asl was recorded at the altitude range from 1040 m to 1250 m asl. Twenty species recorded in this altitude range represents 91 % of all species found at collecting sites located higher than 1000 m asl.

Table 2. Distribution of Pipunculidae according to the altitude of collecting sites.

Locality	Recorded species	Species number	Altitude (asl)
PPB	*Ch. spurius, N. flavicornis, N. lapponicus, C. ultimus, C. vittipes, E. elephas, E. subfascipes*	7	550
PPD	*N. scutellatus*	1	550
BDM	*Ch. argenteus, Ch. basalis, Ch. pughi, Ch. spurius, J. pilosa, V. aucta, C. aeneus, C. obtusinervis, C. subultimus, C. ultimus, C. vittipes, E. furvulus, E. montium, E. obliquus, E. subterminalis, E. zonellus, M. opacus, P. campestris, P. lenis, P. tenuirostris, T. sylvatica, D. maculata, D. xanthocera*	23	609
SSP	*Ch. pughi, Ch. spurius, N. lapponicus, N. scutellatus, C. carinatus, C. obtusinervis, C. vittipes, E. furvulus, E. fuscipes, E. obliquus, E. subfascipes, E. subterminalis, M. opacus, P. campestris, P. tenuirostris, P. violovitshi, P. wolfi, D. confusa, D. rufipes, D. xanthocera*	20	645
SSS	*C. carinatus, C. subultimus, C. ultimus, C. varipes, P. campestris, P. tenuirostris, P. violovitshi, D. xanthocera*	8	645
SSM	*P. campestris*	1	645
ZPB	*Ch. basalis, Ch. spurius, J. pilosa, N. scutellatus, C. aeneus, C. obtusinervis, C. subultimus, C. varipes, C. vittipes, E. carpathicus, E. montium, E. subfascipes, E. subterminalis, P. lenis, P. tenuirostris, P. violovitshi, D. extricata*	18	670
VBF	*Ch. pughi*	1	850
ODB	*D. xanthocera*	1	950
ODP	*D. xanthocera*	1	950
LDR	*J. pilosa, C. aeneus, P. lenis, P. tenuirostris, P. violovitshi, D. albitarsis, D. xanthocera*	7	1040
LHE	*V. aucta, D. xanthocera*	2	1050-1150
UJO	*E. furvulus, P. violovitshi, P. wolfi, T. sylvatica, D. albitarsis, D. confusa*	6	1100
DPB	*T. sylvatica, D. albitarsis, D. confusa, D. xanthocera*	4	1120
VKJ	*Ch. indistinctus, J. villosa, N. lapponicus, C. obtusinervis, C. ultimus, C. varipes, C. vittipes, P. tenuirostris, T. sylvatica, D. albitarsis, D. confusa, D. xanthocera*	12	1120
LBB	*Ch. juliae, J. pilosa, C. obtusinervis, T. sylvatica, D. albitarsis*	5	1250
LRB	*D. xanthocera*	1	1300
MFL	*D. albitarsis*	1	1300
PDP	*D. xanthopus*	1	1300
UDP	*D. albitarsis*	1	1370
UPB	*P. campestris*	1	1407

Cluster analysis of pipunculid species recorded in more than three individuals split them in two main groups of an equal number of species. The first group (*C. aeneus, P. lenis, J. pilosa, C. obtusinervis, P. tenuirostris, D. xanthocera, T. sylvatica, D. albitarsis, D. confusa, E. furvulus, P. violovitshi)* consists of species reaching altitudes over 1,000 m asl with the only exception of *C. aeneus* (hypsometric range 609-670 m asl). On contrary, the second group (*C. subultimus, E. subterminalis, Ch. spurius, C. vittipes, C. ultimus, C. varipes, N. scutellatus, E. subfacipes, N. lapponicus)* includes species with predominant occurrence at localities with an altitude under 1000 m asl (Fig. 2). *N. lapponicus, C. vittipes, C. varipes* were the only exceptions which were recorded at altitude over 1000 m asl.

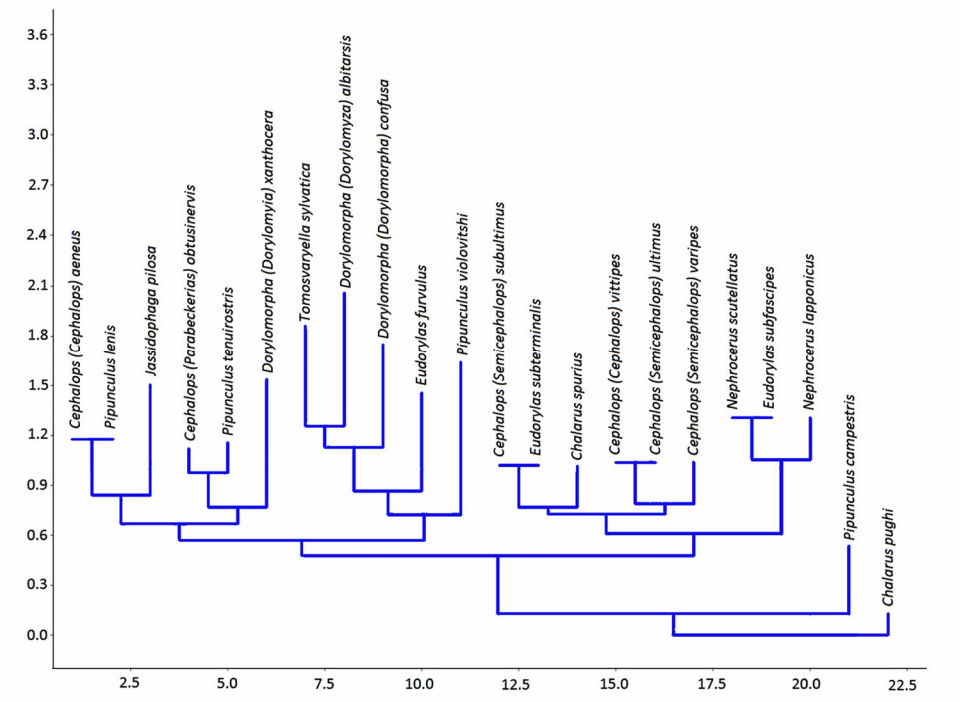

Fig. 2. The cladogram of hypsometric distribution of pipunculid species in Krkonoše Mts.

The DCA analysis confirmed affinity of some pipunculid species to either sub-mountain or with boreo-montane distribution (Fig. 3). These species are clustered as the second subgroup of the first group of cladogram obtained by previous cluster analysis.

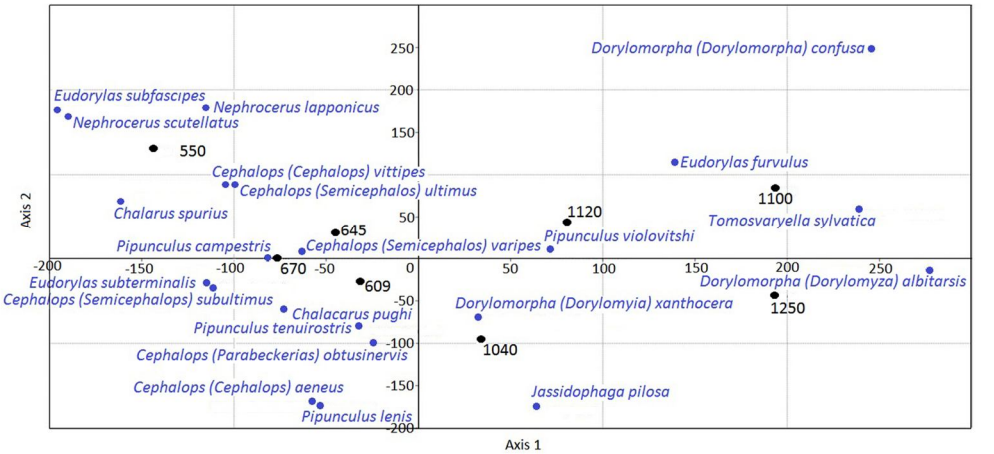

Fig. 3. The hypsometric distribution of pipunculid species according to the elevation at Krkonoše Mts.

DISCUSSION

The fauna of big-headed flies of the Czech Republic is well studied. Altogether, 112 species are known from the country, and 89 were so far recorded from Bohemia (LAUTERER 2009). Detailed studies of the dipteran communities have been performed at several zoogeographically important Bohemian and Moravian localities (LAUTERER 1998, KOZÁNEK & BARTÁK 2000). Despite the fact, that Krkonoše Mts. is the oldest and the second biggest national part of the Czech Republic, the fauna of big-headed flies is very poorly known. The first record of big-headed flies from Krkonoše Mts. originated from DUDA (1940) who described *Clistoabdominalis electus* (Hardy, 1947) from this area. Additionally, LAUTERER (1981) reported *Dorylomorpha* (*Dorylomorpha*) *confusa* (Verrall, 1901) and *Dorylomorpha* (*Dorylomyia*) *incognita* (Verrall, 1901) from here. In the years of 2005-2009, the team of entomologists from Agricultural University, Prague accomplished detailed research of dipteran communities on numerous localities at Krkonoše Mts. resulted in extensive dipteran material included big-headed flies. It comprised of 42 species which extended the list of Pipunculidae from this area up to 44 species. Among them, one species (*Chalarus juliae*) was found for the first time in the Czech Republic and three species (*Chalarus indistinctus*, *Nephrocerus flavicornis* and *Dorylomorpha rufipes*) are first findings for the territory of Bohemia. Faunistically important is finding of *Pipunculus wolfi* Kowarz, 1887 which was considered as a younger synonym of *Pipunculus campestris* Latreille, 1802 until KEHLMAIER (2008a) recognized it as valid species.

The sampling of Pipunculidae within extensive faunistic research of Krkonoše Mts. has been performed at 21 localities but the number of recorded species in more half of them did not exceed five species per site. The higher number of collected big-headed flies at four localities (BDM, SSP, ZPB, VKJ) allowed us to evaluate the dominance level. *C. vittipes* and *E. subfascipes* were eudominant at more than one locality, both of them preferred altitude under 1000 m asl. *D. albitarsis* was the only eudominant species (VKJ) which was recorded at collecting sites with altitude over 1000 m asl.

The hypsometric distribution of European big-headed flies has not been studied in detail, although we can find some anecdotal comments in some mainly faunistic works. KEHLMAIER (2008b) studied fauna of big-headed flies of "Parco Nationale dello Stelvio" (PNS), South Tyrol, Italy and he identify 68 species. Flies were collected in sites with elevation from 940 to 2315 m asl. He sorted all recorded species to five categories (sub-mountain, mountain, oreal, subalpine, alpine) based on the altitude range of their occurrence. The cluster analysis of selected localities of Krkonoše Mts. sorted out collecting sites to group 1 with altitude bellow 1000 m asl which could be considered as analogous of sub-mountain and mountain zone and group 2 with altitude over 1000 m asl analogous with subalpine, alpine zone of KEHLMAIER (2008b). Parco Nationale dello Stevio and Krkonoše Mts. differ in many parameters. The comparison of the zonation of pipunculid fauna indicates the preference of some species to actual hypsometric zone. *C. vittipes*, *E. subfascipes*, *P. lenis*, *P. tenuirostris* were eudominant at localities with elevation up to 700m asl (comparable with sub-mountain and mountain zone of KEHLMAIER (2008b) were at recorded up to oreal and subalpine zone. The occurrence of these species at localities with lower elevation comparing with Parco Nationalle dello Stelvio can be explained by the geographic position of Krkonoše Mts. which are located almost 1000 km northerly.

Cluster and DCA analyses confirmed preference of some species to the specific hypsometric zones which is similar several species of big-headed flies either in PNS or in Krkonoše Mts. This work is the first from the series of prepared papers dealing with faunistics and hypsometric distribution of big-headed flies in several mountain ecosystems of Central Europe. Evaluation of data from further Central European mountains is in progress and the results should help us to understand the patterns of big-headed fly geographic and hypsometric distribution.

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