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Social wasps (Hymenoptera: Vespidae) trapped with beer in European forest ecosystems

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DVOŘÁK L. 2007: Social wasps (Hymenoptera: Vespidae) trapped with beer in European forest ecosystems. *Acta Musei Moraviae, Scientiae biologicae* (Brno) **92:** 181–204. – Social wasps (Hymenoptera, Vespidae) were trapped using beer baits in European forest ecosystems in 2006. In the course of this study, 3583 wasps of 8 species were trapped at 131 locations. The following species fell to the bait: *Polistes dominulus* (Christ, 1791), *Vespa crabro* Linnaeus, 1758, *V. velutina* Lepeletier, 1836, *Vespula germanica* (Fabricius, 1793), *V. rufa* (Linnaeus, 1758), *V. vulgaris* (Linnaeus, 1758), *Dolichovespula media* (Retzius, 1783), and *D. saxonica* (Fabricius, 1793). *V. vulgaris* and *V. crabro* were the eudominant species, with more than 40% of individuals. The third most common species was *D. media*, a species considered rare or uncommon by many authors. One very interesting result of the study was a specimen of *V. velutina*, an Asian species established in southern France within the last two years.

Key words. Vespidae, *Vespa*, *Vespula*, *Dolichovespula*, *Polistes*, Europe, bait traps, forest ecosystems

Introduction

DVOŘÁK & LANDOLT (2006) have published that baited traps are very attractive for certain European wasp species. Their material is not as extensive as similar studies from North America (see LANDOLT et al. 2005 for review), so further research seemed indicated. This paper works with the results of trapping with beer using a very simple method. The aim of the paper is to characterize the fauna of social wasps attracted by beer traps in forests and evaluate the differences between some aspects of the forest stands.

Material and methods

Wasps were trapped by a very simple method. A clear polyethylene (PET) bottle of 1.5 or 2 litres, colourless and transparent (among other senses, wasps use sight for orientation), was filled with 0.5 litres of beer. The bottle was hung on a branch approximately 1.5 m above the ground, with an easily accessible entrance. The research was focused on forest ecosystems, so the traps were situated in closed forests (minimum 100 m from the forest margin), not in the ecotone. Installation of the traps took place around 10 July (plus or minus a few days) and the traps were recovered after 30–35 days. One trap was placed at each site (with only two or three exceptions).

The data originates from only 2006, with no replication in other years. The data are not statistically evaluated because of a lack of certain information from individual trapping sites.

The data for each location are listed in the following order: Country abbreviation with serial number, county and/or geographical unit, locality/location (with the faunistic code number in CZE, SVK, and UK), biotope, altitude, coordinates (if available), date of installation and recovery, and name of the collector. The localities of the ALARM Project (http://www.alarmproject.net/alarm/) are marked as disturbed or undisturbed. The trapping sites are shown in Fig. 1.

Species abbreviations used in figures and in Table 1:

Pdom . . . . . *Polistes dominulus*
Vcra . . . . . *Vespa crabro*
Vvel . . . . . *V. velutina*
Vger . . . . . *Vespula germanica*
Vruf . . . . . *V. rufa*
Vvul . . . . . *V. vulgaris*
Dmed . . . . . *Dolichovespula media*
Dsax . . . . . *D. saxonica*

Localities studied.

BEL 1 Ardenne méridionale, Vague des Gomets, mixed broadleaf forest, 380 m.a.s.l., 15.vii.–22.viii.2006, Jean-Luc Renneson.

BEL 2 central Belgium, Braine-l'Alleud (close to Waterloo), spruce woodland, 106 m.a.s.l., 50.696576° N, 4.390525° E, 11.vii.–10.viii.2006, Nicolas J. Vereecken.

BEL 3 central Belgium, Braine-l'Alleud (close to Waterloo), spruce woodland, 106 m.a.s.l., 50.696576° N, 4.390525° E, 11.vii.–10.viii.2006, Nicolas J. Vereecken.

CZE 1 Pavlovské kopce hills, Pavlov, 7165, S part of Děvín National Nature Reserve (NNR), humic lime-maple-ash forest, 320 m.a.s.l., 48°52'39.17" N, 16°39'50.06" E, 4.vii.–4.viii.2006, Libor Dvořák.

CZE 2 Litovelské Pomoraví lowlands, Střeň, 6269, ca. 1 km NNE, lime-oak forest, 225 m.a.s.l., 49°42'08.78" N, 17°10'00.74" E., 8.vii.–12.viii.2006, Michal Maňas

CZE 3 Litovelské Pomoraví lowland, Pňovice, 6268, ca. 1.4 km SW, alder forest admixed with other trees, 225 m.a.s.l., 49°42'47.90" N, 17°08'28.65" E, 8.vii.–12.viii.2006, Michal Maňas.

CZE 4 Borkovice, Borkovická blata peat-bog, 6753, bog pine forest, 49°13'46.85" N, 14°37'35.84" E,14.vii.–15.viii.2006, Jan Máca.

CZE 5 Českomoravská vrchovina highlands, Habry, 6258, secondary spruce forest, 480 m.a.s.l., 7.vii.–11.viii.2006, Kamil Holý.

CZE 6 Šumava Mts., Řetenice – „Ramajzl", 6847, N margin of Amálino údolí NR, alder wood, 770 m.a.s.l., 11.vii.–10.viii.2006, Libor Dvořák.

CZE 7 Šumava Mts., Kvilda, 6947, E margin of Jezerní slať NNR, waterlogged spruce forest, 1075 m.a.s.l., 13.vii.–14.viii.2006, Libor Dvořák.

CZE 8 Šumava Mts., Kyselov, Borková NR, 7350, bog pine forest, 730 m.a.s.l., 18.vii.–18.viii.2006, Josef Majer.

CZE 9 Šumava Mts. foothills, Milíkov, 6848, pine forest SE of village, 740 m.a.s.l., 49°8’25.87”, 13°42’12.88”, 13.vii.–12.viii.2006, Libor Dvořák.

CZE 10 Šumava Mts. foothills, Čepice, 6747, spruce-pine forest at Čepičná NR, 515 m.a.s.l., 49°16’26.56”, E:13°35’27.49”, 15.vii.–15.viii.2006, Václav Turek.

CZE 11 Drahanská vrchovina highlands, Ochoz u Brna, 6666, oak-hornbeam forest SE of village, 380 m.a.s.l., 9.vii.–11.viii.2006, Libor Mikulica.

CZE 12 Drahanská vrchovina highlands, Ochoz u Brna, 6666, old beech forest 700 m NNEof a village, 440 m.a.s.l., 9.vii.–11.viii.2006, Libor Mikulica.

CZE 13 Nízký Jeseník Mts., Výškovice, 6174, secondary spruce forest, 480 m.a.s.l., 49°46’37.46” N, 18°14’1.76” E, 14.vii.–14.viii.2006, Jaroslav Holuša.

CZE 14 Ostravská pánev lowland, Ostrava Zábřeh, 6275, oak-elm forest in Polanský les forest, 215 m.a.s.l., 14.vii.–14.viii.2006, Magdalena Roháčová.

CZE 15 Krušné hory Mts., Horní Litvínov, 5347, beech forest admixed with other trees, 440 m nm, 5.vii.–6.viii.2006, Pavel Tyrner.

CZE 16 Bobravská vrchovina highlands, Omice, 6864, oak forest ca. 600 m W, 380 m.a.s.l., 49°10’17” N, 16°26’38” E, 13.vii.–13.viii.2006, Petr Komzák.

CZE 17 Bobravská vrchovina highlands, Omice, 6864, pine forest ca. 1.4 km W, 390 m.a.s.l., 49°10’31 N”, 16°26’04” E, 13.vii.–13.viii.2006, Petr Komzák.

CZE 18 Českomoravská vrchovina highlands, Smrčná, 6559, blossoming beech forest with maple trees ca. 450 m NE of Vysoký kámen Mt., 610 m.a.s.l., 49°27’55” N, 15°34’20” E, 15.vii.–19.viii.2006, Petr Komzák.

CZE 19 Českomoravská vrchovina highlands, Smrčná, 6559, secondary spruce forest ca. 800 m S of Vysoký kámen Mt., 620 m.a.s.l., 49°27’20” N, 15°34’02” E, 15.vii.–19.viii.200, Petr Komzák.

CZE 20 Český les Mts., Stará Huť, 6542, secondary spruce forest, 575 m.a.s.l., 20.vii.–17.viii.2006, Petra Cehlárikova.

CZE 21 Český les Mts., Pleš NR, 6441, acidophilous beech forest, 755 m.a.s.l., 20.vii.–17.viii.2006, Petra Cehlárikova.

CZE 22 Český les Mts., Capartice, 6542, Skalky na Sadku, secondary spruce forest, 735 m.a.s.l., 20.vii.–17.viii.2006, Petra Cehlárikova.

CZE 23 Český les Mts., Diana NR, 6341, acidophilous beech forest, 485 m.a.s.l., 20.vii.–17.viii.2006, Petra Cehlárikova.

CZE 24 Český les Mts., Přimda NR, 6341, blossoming beech forest, 700 m.a.s.l., 20.vii.–18.viii.2006, Petra Cehlárikova.

CZE 25 Křivoklátsko, Habr, 6247, 1 km N of village, secondary spruce forest, 470 m.a.s.l., 16.vii.–17.viii. 2006, Václav Říš.

CZE 26 Křivoklátsko, Volduchy, 6247, 1 km N of a village, secondary pine young plantation, 488 m.a.s.l., 49°47’42.78” N, 13°37’33.53” E, 16.vii.–17.viii. 2006, Václav Říš.

CZE 27 Křivoklátsko, Březina, 6247, 1 km SW of a village, acidophilous beech forest with admixed pines, 570 m.a.s.l., 49°48’14.16” N, 13°34’44.54” E, 16.vii.–17.viii. 2006, Václav Říš.

CZE 28 Prague City, Praha - Kunratice, 5952, Kunratický les forest, mixed forest with high spruce representation, 305 m.a.s.l., 10.vii.–11.viii.2006, Petr Kment.

CZE 29 Bobravská vrchovina highlands, Silůvky, 6864, xerophilous oak forest in Klínky forest, 305 m.a.s.l., 11.vii.–14.viii.2006, Erich Kment.

CZE 30 Litovelské Pomoraví, Přerov, 6570, N part of Žebračka NNR, floodplain forest with hornbeam and ash, 210 m.a.s.l., 15.vii.–18.viii.2006, Dušan Vepřek.

CZE 31 Litovelské Pomoraví, Přerov, 6570, S part of Žebračka NNR, floodplain forest with hornbeam and ash, 49°27’50.27” N, 17°28’13.12” E, 210 m.a.s.l., 15.vii.–18.viii.2006, Dušan Vepřek.

CZE 32 Hradec Králové – Nový Hradec Králové, 5861, town park forest S of cemetery, secondary pine forest with other trees admixed, 250 m.a.s.l., 50°10’57” N, 15°52’33” E, 14.vii.–14.viii.2006, Šárka Mikátová et Miroslav Mikát.

CZE 33 Hradec Králové – Nový Hradec Králové, 5861, town park forests, oak-hornbeam forest, 245 m.a.s.l., 50°10’44” N, 15°52’11” E, 14.vii.–14.viii.2006, Šárka Mikátová et Miroslav Mikát.

CZE 34 Podyjí NP, Lukov, Vraní skála rock, 7161, xerophilous oak forest with other trees admixed, 400 m.a.s.l., 48°51’2.06” N; 15°53’43.67” E, 10.vii.–11.viii.2006, Václav Křivan.

CZE 35 Podyjí NP, Čížov, Kozí stezky, 7161, hornbeam-oak forest, 410 m.a.s.l., 48°51’41.1” N, 15°51’59.54” E, 10.vii.–11.viii.2006, Václav Křivan.

CZE 36 Podyjí NP, Hnanice, Thaya River valley, Lipinská lávka, 7161, mixed broadleaf forest on rocky debris, 250 m.a.s.l., 48°49’7.67” N, 15°58’12.46” E, 10.vii.–11.viii.2006, Václav. Křivan.

CZE 37 Českomoravská vrchovina highlands, Štěměchy – Dašov, 6860, secondary spruce forest, 650 m.a.s.l., 49°11’50” N, 15°42’56” E, 11.vii.–12.viii.2006, Václav Křivan.

CZE 38 Jizerské hory Mts., Jizerka, Kořenov, 5158, Rašeliniště Jizerky NNR, margin of waterlogged spruce forest, 880 m.a.s.l., 26.vii.–26.viii.2006, Jiří Preisler et Pavel Vonička.

CZE 39 Jizerské hory Mts., Jizerka, Kořenov, 5158, Na Kobyle, margin of spruce forest, 900 m.a.s.l., 50°47’55.48”N, 15°21’7.9”E, 26.vii.–26.viii.2006, Jiří Preisler et Pavel Vonička.

CZE 40 Ještědský hřbet ridge, Jitrava, 5255, Velký Vápenný NNR, blossoming beech forest, 550 m.a.s.l., 20.vii.–22.viii.2006, Jiří Preisler and Pavel Vonička.

CZE 41 Brdy Mts. foothills, Rymáně, 6151, Hora hill, beech forest, 420 m.a.s.l., 49°51'36"N, 14°17'56"E, 15.vii.–18.viii.2006, Magda Hrabáková.

CZE 42 Brdy Mts. foothills, Rymáně, 6151, Hora hill, secondary spruce forest, 440 m.a.s.l., 49°51'26"N, 14°17'51"E, 15.vii.–18.viii.2006, Magda Hrabáková.

ESP 1 Garraf (Barcelona), Sitges, 31 T, Mediterranean region, garrigue with *Pinus halepensis*, 213 m.a.s.l., x: 0403037, y: 4568985, 13.vii.–17.viii.2006, Jara Andreu, natural site.

ESP 2 Garraf (Barcelona), Sitges, 31 T, Mediterranean region, garrigue with *Pinus halepensis*, 120 m.a.s.l., x: 0403546, y: 4568508, 13.vii.–17.viii.2006, Jara Andreu, natural site.

ESP 3 Garraf (Barcelona), Sitges, 31 T, Mediterranean region, garrigue with *Pinus halepensis*, 131 m.a.s.l., x: 0403649, y: 4568553, 13.vii.–17.viii.2006, Jara Andreu, natural site.

ESP 4 Garraf (Barcelona), Viladellops (Olèrdola), 31 T, Mediterranean region, garrigue with *Pinus halepensis*, 225 m.a.s.l., x: 0393965, y: 4574130, 13.vii.–17.viii.2006, Jara Andreu, disturbed site.

ESP 5 Garraf (Barcelona), Viladellops (Olèrdola), 31 T, Mediterranean region, garrigue with *Pinus halepensis*, 221 m.a.s.l., x: 0394040, y: 4574025, 13.vii.–17.viii.2006, Jara Andreu, disturbed site.

ESP 6 Garraf (Barcelona), Viladellops (Olèrdola), 31 T, Mediterranean region, garrigue with *Pinus halepensis*, 217 m.a.s.l., x: 0394007, y: 4574082, 13.vii.–17.viii.2006, Jara Andreu, disturbed site.

ESP 7 Tarragona, Prades Mts., holm oak (*Quercus ilex*) forest, 930 m.a.s.l., x: 0335475, y: 4578599, 20.vii.–21.viii.2006, Romá Ogaya.

ESP 8 Toledo, forest with *Quercus rotundifolia*; Underbrush composed of *Daphne gnidium*, *Thymus* sp., *Phillyrea angustifolia*, 850 m.a.s.l., x: 0409666, y: 4350852, 12.vii.–16.viii.2006, Esther Charles Jordán, disturbed site.

ESP 9 Toledo, area with *Pinus pinaster*, without underbrush, 780 m.a.s.l., x: 0408187, y: 4361126, 12.vii.–16.viii.2006, Esther Charles Jordán, undisturbed site.

ESP 10 Toledo, semi-natural forest with *Pinus pinaster*, *Quercus faginea*, and underbrush with *Erica arborea*, *Cistus ladanifer*, 780 m.a.s.l., x: 0408295, y: 4363359, 12.vii.–16.viii.2006, Esther Charles Jordán, undisturbed site.

ESP 11 Toledo, natural forest with *Quercus faginea*, underbrush with *Cistus ladanifer*, *Thymus* sp., 780 m.a.s.l., x: 0407628, y: 4362678, 12.vii.–16.viii.2006, Esther Charles Jordán, undisturbed site.

EST 1 Järvamaa, Koeru, spruce forest with several *Fraxinus* and maple trees, 98 m.a.s.l., 58°58,578'N, 26°02,758'E, 19.vii.–22.viii.2006, Kersti Püssa, natural site.

EST 2 Järvamaa, Koeru, spruce forest with several *Fraxinus* and maple trees, 103 m.a.s.l., 58°59,416'N, 26°00,588'E, 19.vii.–22.viii.2006, Kersti Püssa, natural site.

EST 3 Järvamaa, Väike-Maarja, spruce forest with several *Fraxinus* and maple trees, 120 m.a.s.l., 59°10,352'N, 26°17,916'E, 19.vii.–22.viii.2006, Kersti Püssa, disturbed site.

EST 4 Järvamaa, Väike-Maarja, spruce forest with several *Fraxinus* and maple trees, 117 m.a.s.l., 59°08,864'N, 26°18,572'E, 19.vii.–22.viii.2006, Kersti Püssa, disturbed site.

FRA 1 Aquitaine, Villandraut, spontaneous *Robinia pseudoacacia* forest, 30 m.a.s.l., 0°22'30"W 44°28'N, 10.vii.–10.viii.2006, Francois Dittlo.

FRA 2 Ille-de-France, Marchais, broadleaf forest (dominant species: *Carpinus betulus, Quercus petraea, Castanea sativa*), 120 m.a.s.l., 48°31.584' N, 2°04.774' E, 11.vii.–10.viii.2006, Aurélie Pottier, disturbed site.

FRA 3 Ille-de-France, Bonnelles, broadleaf forest (dominant species: *Betula pendula, Fraxinus excelsior*), 112 m.a.s.l., 48°36.702' N, 2°01.202' E, 11.vii.–10.viii.2006, Aurélie Pottier, undisturbed site.

GER 1 Oberbayern, Traunstein, Reit im Winkl, spruce-beech forest, 800 m.a.s.l., 10.vii.–10.viii.2006, Klaus Wieser.

GER 2 Oberbayern, Traunstein, Reit im Winkl, spruce-beech forest, 900 m.a.s.l., 10.vii.–10.viii.2006, Klaus Wieser.

GER 3 Oberbayern, Traunstein, Reit im Winkl, light mixed forest, 1180 m.a.s.l., 10.vii.–10.viii.2006, Klaus Wieser.

GER 4 Oberbayern, Traunstein, Reit im Winkl, light spruce forest on stony debris, 1380 m.a.s.l., 10.vii.–10.viii.2006, Klaus Wieser.

GER 5 Bayern, NP Bayerischer Wald, Lackenberg, sunny spruce forest, 1174 m.a.s.l., x: 4594471, y: 5440999, 10.vii.–10.viii.2006, Jörg Müller.

GER 6 Bayern, NP Bayerischer Wald, Falkenstein, sunny spruce forest, 1240 m.a.s.l., x: 4593781, y: 5439899, 10.vii.–10.viii.2006, Jörg Müller.

GER 7 Bayern, NP Bayerischer Wald, Mittelsteighütte, beech-fir virgin forest, 786 m.a.s.l., x: 4591576, y: 5441034, 10.vii.–10.viii.2006, Jörg Müller.

GER 8 Bayern, NP Bayerischer Wald, Watzlik-Hain, beech-fir virgin forest, 699 m.a.s.l., x: 4589906, y: 5440889, 10.vii.–10.viii.2006, Jörg Müller.

GER 9 Lower Saxony, Barterode, Kattenbuehl, *Pinus sylvestris* forest, 260 m.a.s.l., x: 3553556.82, y: 5710527.87, 10.vii.–14.viii.2006, Mareike Irskens, disturbed site.

GER 10 Lower Saxony, Barterode, Ossenberg, *Fagus sylvatica* forest, 365 m.a.s.l., x: 3554786.48, y: 5711710.59, 10.vii.–14.viii.2006, Mareike Irskens, disturbed site.

GER 11 Hesse, Rossbach, Muehlenstein, *Picea abies* forest, 340 m.a.s.l., x: 3555385.70, y: 5687312.67, 10.vii.–14.viii.2006, Mareike Irskens, undisturbed site.

GER 12 Hesse, Rossbach, Pfaffenberg, *Fagus sylvatica* forest, 250 m.a.s.l., x: 3556661.80 y: 5687568.36, 10.vii.–14.viii.2006, Mareike Irskens, undisturbed site.

GRE 1 Lesvos isl., Mytilini, *Pinus brutia* forest, park inside town, 32 m.a.s.l., 39°06' 36'' N, 26°33' 53'' E, 10.vii.–10.viii.2006, Babis Petsikos, disturbed site.

GRE 2 Lesvos isl., Mystegna, *Pinus brutia* forest, 150 m.a.s.l., 39°10' 40'' N, 26°25' 50'' E, 10.vii.–10.viii.2006, Babis Petsikos, natural site.

GRE 3 Lesvos isl., Mystegna, maquis shrubland, 21 m.a.s.l., 39°12' 13'' N, 26°29' 10'' E, 10.vii.–10.viii.2006, Babis Petsikos, natural site.

IRL 1 Galway, Creglucas, mixed woodlands, 10.vii.–10.viii.2006, Siobhán McNamee, semi-natural site.

IRL 2 Galway, Esker, mixed woodlands, 10.vii.–10.viii.2006, Siobhán McNamee, disturbed site.

ITA 1 Livenza (Pordenone), Friuli piedmont, sycamore forest with ash on stony debris, 60 m.a.s.l., 12.vii.–16.viii.2006, Rosso Marco.

ITA 2 Livenza (Pordenone), by the Livenza river spring, *Acer campestre*, *Ontano nero*, *Corylus avellana*, and *Salix babylonica* forest, 50 m.a.s.l., 12.vii.–16.viii.2006, Rosso Marco.

LTH 1 Dűkđtos, natural protected oak forest: *Quercus robur* dominant (avg. stand 180 years), *Corylus avellana*, *Carex pilosa*; some *Betula* sp., *Populus tremula*, etc., 131 m.a.s.l., 54°50'20" N, 24°57'52" E, 12.vii.–18.viii.2006, Eduardas Budrys, natural site.

LTH 2 Puvočiai, managed semi-natural pine forest: *Pinus silvestris* dominant (avg. stand 50 years), *Juniperus communis*, *Vaccinium vitis-idaea*, *V. myrtillus*, *Pleurozium schreberi*; some *Betula pendula*, *Picea abies*, 115 m.a.s.l., 54°06'28" N, 24°18'47" E, 14.vii.–20.viii.2006, Eduardas Budrys.

LTH 3 Puvočiai, natural alluvial forest: *Alnus glutinosa*, *Prunus padus* dominant; some *Carpinus betulus*, *Populus tremula*, *Evonymus verrucosa*, 89 m.a.s.l., 54°06'57" N, 24°17'34" E, 14.vii.–20.viii.2006, Eduardas Budrys.

LTH 4 Kiemeliai, fragment (2 ha) of secondary forest in arable land: *Betula pendula*, *Populus tremula* dominant (stand ca. 70 years); some *Quercus robur*, *Sorbus aucuparia*, *Corylus avellana*, *Padus avium*, 110 m.a.s.l., 54°51'53" N, 25°01'55" E, 24.vii.–27.viii.2006, Eduardas Budrys disturbed site.

POL 1 Malopolska Upland, Piekary, Góra Grodzisko, *Carpinus betulus, Betula pendula* forest, 252 m.a.s.l., 34 U 0414418, UTM 5540177; 50°00'27,9" N, 19°48'20,3" E, 13.vii.–16.viii.2006, Hajnalka Szentgyörgyi, disturbed site.

POL 2 Malopolska Upland, Piekary, Bogucianka: *Betula pendula, Pinus sylvestris* forest, 241 m.a.s.l., 34 U 0415047, UTM 5540850;

50°00’50,1” N, 19°48’51,3” E, 13.vii.–16.viii.2006, Hajnalka Szentgyörgyi, disturbed site.

POL 3 Malopolska Upland, Pychowice, Las Wolski: *Fagus sylvatica, Carpinus betulus* forest, 265 m.a.s.l., 34 U 0418823, UTM 5544687; 50°02’56,2” N, 19°51’58,1” E, 13.vii.–16.viii.2006, Hajnalka Szentgyörgyi, natural site.

POL 4 Malopolska Upland, Pychowice, Góra Pychowicka: *Acer platanoides, Fraxinus excelsior* forest, 222 m.a.s.l., 34 U 0419968, UTM 5542688; 50°01’52,0” N, 19°52’57,2” E, 13.vii.–16.viii.2006, Hajnalka Szentgyörgyi, natural site.

SVK 1 Strážovské Vrchy Mts., Opatová nad Váhom, Opatovska dolina, 7074, thermophilous oak forest NE of a lake, 340 m.a.s.l., 14.vii.–15.viii.2006, Peter Liška.

SVK 2 Strážovské Vrchy Mts., Opatová nad Váhom, Opatovska dolina, 7074, oak-hornbeam forest with many shrubs, 290 m.a.s.l., 14.vii.–15.viii.2006, Peter Liška.

SVK 3 Strážovské Vrchy Mts., Opatová nad Váhom, Opatovska dolina, 7074, beech forest on limestone, almost without bushes, 300 m.a.s.l., 14.vii.–15.viii.2006, Peter Liška.

SVK 4 Podunajská Rovina lowland, Nové Zámky, Berek forest park, 8074, secondary forest with *Quercus* and *Fraxinus*, 113 m.a.s.l., 15.vii.–19.viii.2006, Peter Šima.

SVK 5 Hronská Niva lowland, Vozokanský luh Nature Reserve, 7978, *Salix-Populus* floodplain forest, 130 m.a.s.l., 13.vii.–16.viii.2006, Vladimír Smetana.

SVK 6 Hronská Niva lowland, Vozokanský luh Nature Reserve, 7978, *Salix-Populus* floodplain forest, Hron river side-channel, 130 m.a.s.l., 13.vii.–16.viii.2006, Vladimír Smetana.

SVK 7 Ipeľská Pahorkatina, Kmeťovce, 7778, *Robinia* forest, 220 m.a.s.l., 13.vii.–16.viii.2006, Vladimír Smetana.

SVK 8 Štiavnické Vrchy Mts., Bohunice, 7678, oak forest, 320 m.a.s.l., 13.vii.–16.viii.2006, Vladimír Smetana.

SVK 9 Štiavnické Vrchy Mts., Kotliny, 7678, maple and oak forest on rocky debris, 504 m.a.s.l., 13.vii.–16.viii.2006, Vladimír Smetana.

SVK 10 Štiavnické Vrchy Mts., Krížny buk (pass), 7678, oak forest, 630 m.a.s.l., 13.vii.–16.viii.2006, Vladimír Smetana.

SWE 1 Lapland, Abisko, birch forest, 393 m.a.s.l., 68°21,178’ N, 18°49,081’ E, 12.vii.–15.viii.2006, Olga Bohuslavová.

SWI 1 Jura, Delémont, mixed forest. Principal trees and shrubs present around the trap: *Fagus sylvatica, Lonicera xylosteum, Rubus, Corylus avellana, Fraxinus excelsior, Sambucus nigra, Acer pseudoplatanus* and *Pinaceae*, 506 m.a.s.l., 47°24’69” N, 7°19’39” E, 10.vii.–15.viii.2006, Christelle Péré.

UK 1 Banes, Newton Park, Vinery Wood, ash forest, 75 m.a.s.l., ST693637, 51°22’17” N, 2°26’31” W, 6.vii.–9.viii.2006, Darrel Watts.

UK 2–3 Staffordshire, Staffordshire Moorlands, West Midlands, Consall Nature Park, upland oak/ silver birch woodland with old coppice hazel understorey, SJ993479, 7.vii.–5.viii.2006, James Hill.

UK 4 Middlesex, Hanger Wood, small, ancient woodland fragment in suburban area, clay soil, mixed deciduous trees, 65 m.a.s.l., TQ186820, 11.vii.–12.viii.2006, Mike Fox.

UK 5 Wiltshire, Blackmoor Copse, ancient deciduous coppice woodland with standards. *Quercus*, *Fraxinus*, *Acer campestre* and *Corylus avellana*, at edge of large clearing with regenerating shrubs, 65 m.a.s.l., SU232291, 51.060231°N, 1.668908° W, 12.vii.–15.viii.2006, Stuart P.M. Roberts.

UK 6 Hampshire, New Forest; Bramshaw Wood, open grazed wood pasture, *Fagus*, *Quercus*, *Betula* with *Ilex aquifolium* understorey, at edge of small clearing, 65 m.a.s.l., SU256171, 50.952212° N, 1.635529° W, 12.vii.–15.viii.2006, Stuart P.M. Roberts.

UK 7 Hampshire, New Forest; Millersford Plantation, coniferous plantation. *Pinus sylvestris*, at side of broad track through plantation, 100 m.a.s.l., SU200175, 50.956035° N, 1.715218° E, 12.vii.–15.viii.2006, Stuart P.M. Roberts.

UK 8 Strumpshaw, Norfolk, wet floodplain forest on alluvial peat (*Alnus*), <5m.a.s.l., TG344057, 11.vii.–12.viii.2006, Tim Strudwick.

UK 9 Strumpshaw, Norfolk, mixed deciduous woodland at floodplain edge on sand/gravel (*Alnus*, *Salix*, *Fraxinus*, *Quercus*, *Betula*), <5m.a.s.l., TG341064, 11.vii.–12.viii.2006, Tim Strudwick.

UK 10 Berkshire, Newbury, Lambourn Downs, oak, sycamore, young plantation, no ground cover, 139 m.a.s.l., SU 43891768, 51°29’19.7” N, 1°26’28.0” W, 11.07.–10.08.2006, Emily Gillian Chambers, disturbed.

UK 11 Berkshire, Newbury, Lambourn Downs, beech, oak, ash, mature wood, brambles, 171 m.a.s.l., SU 43991757, 51°28’43.9” N, 1°25’36.6” W, 11.07.–10.08.2006, Emily Gillian Chambers, disturbed.

UK 12 Berkshire, Newbury, Lambourn Downs, sycamore, oak, ash, beech, mature wood, sparse dog’s mercury, bluebells, some brambles, 166 m.a.s.l., SU 43741741, 51°27’52.7” N, 1°27’46.8”W, 11.07.–10.08.2006, Emily Gillian Chambers, disturbed.

UK 13 Berkshire, Newbury, Lambourn Downs, beech, elder, ash, field maple, mature wood, nettles, 151 m.a.s.l., SU 43861736, 51°27’36.2” N, 1°26’44.8” W, 11.07.–10.08.2006, Emily Gillian Chambers, disturbed.

UK 14 Berkshire, Newbury, Lambourn Downs, beech, ash, sycamore, mature wood, nettles, 101 m.a.s.l., SU 44051735, 51°27’32.5” N, 1°25’06.4” W, 11.07.–10.08.2006, Emily Gillian Chambers, disturbed.

UK 15 Berkshire, Newbury, Lambourn Downs, oak, ash, sycamore, mature wood, ivy, nettles, 176 m.a.s.l., SU 44001768, 51°29’19.5” N, 1°25’31.0” W, 11.07.–10.08.2006, Emily Gillian Chambers, disturbed.

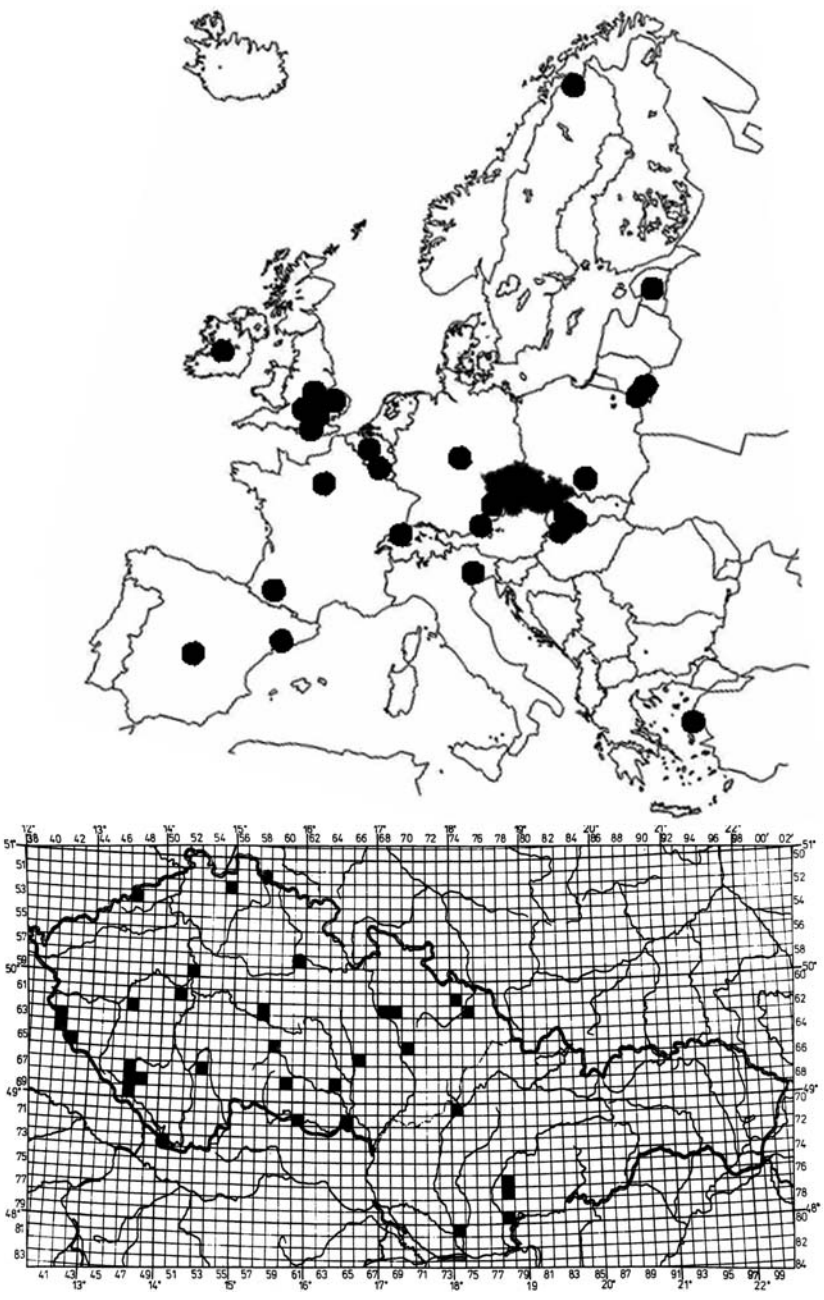

Fig. 1. A schematic map of the localities under study. Localities in the Czech Republic and Slovakia are shown in the faunistic mapping grid.

UK 16 Berkshire, Reading, Chilterns, beech, silver fir, mature wood, brambles, dog's mercury, 122 m.a.s.l., SU 462218, 51°31'15.3", 1°06'17.6" W, 11.07.–11.08.2006, Emily Gillian Chambers, undisturbed.

UK 17 Berkshire, Reading, Chilterns, beech, oak, mature wood, bramble, bracken., 147 m.a.s.l., SU 46301809, 51°31'24.7" N, 1°05'35.9" W, 11.07.–11.08.2006, Emily Gillian Chambers, undisturbed.

UK 18 Berkshire, Reading, Chilterns, silver birch, oak, silver fir, mature wood, nettles, brambles, bracken, ground ivy, var. forbs, grass, moss, 161 m.a.s.l., SU 46331804, 51°31'08.3" N, 1°05'20.7" W, 11.07.–11.08.2006, Emily Gillian Chambers, undisturbed.

UK 19 Berkshire, Reading, Chilterns, ash, beech, yew, mature wood, sparse dog's mercury, 49 m.a.s.l., SU 46161795, 51°30'39.9" N, 1°06'49.4" W, 12.07.–11.08.2006, Emily Gillian Chambers, undisturbed.

UK 20 Berkshire, Reading, Chilterns, beech, mature wood, bramble, bracken, 167 m.a.s.l., SU 46341798, 51°30'48.9" N, 1°05'15.9" W, 12.07.–11.08.2006, Emily Gillian Chambers, undisturbed

UK 21 Berkshire, Reading, Chilterns, beech, sycamore, holly, mature wood, ivy., 147 m.a.s.l., SU 46341789, 51°30'19.8" N, 1°05'16.5" W, 12.07.–11.08.2006, Emily Gillian Chambers, undisturbed.

UK 22–23 North Hampshire, Rake Hangar, beech, birch, 90m.a.s.l., SU 794264, 14.vii.–13.viii.2006, Sarah Patton

UK 24–25 North Hampshire, Rake Hangar, oak, birch, 90 m.a.s.l., SU 794264, 14.vii.–13.viii.2006, Sarah Patton.

UK 26 Oxfordshire, Shotover Hill (SSSI), Midvale Ridge, Johnson's Piece, mixed deciduous natural woodland, over 100 years old, 155 m.a.s.l., SP 565060, 11.07.–15.08.2006, Alex Rey and Xenia Snowman.

UK 27 Oxfordshire, Shotover Hill (SSSI), Midvale Ridge, Horspath Common, derelict 30-year-old broadleaf plantation with older birch, sycamore and ash, 125 m.a.s.l., SP 573054, 11.07.–15.08.2006, Alex Rey and Xenia Snowman.

UK 28–29 Oxfordshire, Shotover Hill (SSSI), Midvale Ridge, Brasenose, coppiced with standards (ancient semi natural woodland), 90 m.a.s.l., SP 560052, 11.07.–15.08.2006, Alex Rey and Xenia Snowman.

As most of the locations studied were situated in the central part of Europe, the major part of the literature discussed originates in the Czech Republic, Slovakia, Germany, and Poland.

Results and Discussion

General.

In the course of our study, 3583 wasps of 8 different species were trapped at 131 sites (see Table 1). The wasps belong to the following species: *Polistes dominulus*

(Christ, 1791), *Vespa crabro* Linnaeus, 1758, *V. velutina* Lepeletier, 1836, *Vespula germanica* (Fabricius, 1793), *V. rufa* (Linnaeus, 1758), *V. vulgaris* (Linnaeus, 1758), *Dolichovespula media* (Retzius, 1783), and *D. saxonica* (Fabricius, 1793). As Fig. 3 shows, two species were eudominant with more than 40% of individuals: *V. vulgaris* and *V. crabro*, both belonging to the most common European forest species (Dvořák & Roberts 2006). Both are regularly taken at bait traps (Dvořák & Landolt 2006). The third most common species was *D. media*, considered a rare or uncommon species by many authors. This raises the question of whether this species is becoming more common or our trapping method is particularly efficacious for *D. media*. In contrast, *V. germanica* is a common species regularly attracted by bait traps (Dvořák & Landolt 2006). Its low numbers can be easily explained by the silviphobic tendencies of this species. Among the other trapped species, *V. rufa* and *D. saxonica* are common in forests, but are only occasionally taken in bait traps (Dvořák & Landolt 2006). *P. dominulus*, like other *Polistes* species, is silviphobic. One very interesting result is a specimen of *V. velutina* at locality FRA 1. This Asian species has become established in southern France within the last two years (Haxaire et al. 2006).

The three most common species were also euconstant (they occurred at more than 45% of sites): *V. vulgaris* (97 localities), *V. crabro* (79), and *D. media* (63). One species, *V. germanica*, was invariable (30 localities, i.e. 23%), other species occurred sporadically: *V. rufa* (9), *D. saxonica* (4), *P. dominulus* (4), and *V. velutina* (1). Only 13 localities were without wasps. For more details see Table 1. The four most common species in the presented study were the only species trapped by Landolt et al. (2007) using chemical attractants in Hungary.

For log-transformed results see Fig. 2. The long transformation is used for the more transparent results because of the high disproportion in numbers of the various wasp species.

Geographical patterns.

All the trapping sites were divided into four geographical groups: (a) islands – UK, IRL, (b) northern Europe – SWE, LIT, EST, (c) central Europe – BEL, CZE, GER, ITA, SVK, SWI, POL, (d) southern parts of Europe – FRA, SPA, GRE. The results are influenced by varying numbers of localities and, of course, the number of wasps (1195, 418, 2184, 68 respectively). Several of the aspects separating these four areas are visible in Fig. 4. The United Kingdom and Ireland have a similar percentage representation of two species, *V. vulgaris* and *V. crabro* (Fig. 4a). However, the high representation of *D. media* (16%), which is a new member of the UK wasp fauna, is quite interesting (see Dvořák & Roberts 2007 for current distribution). Northern Europe can be characterised by a lower number of *V. crabro* (Fig. 4b), which is relatively rare in northern Europe (Pekkarinen & Huldén 1995) and by higher numbers of *V. germanica* and *V. rufa* (probably influenced by trapping in the waterlogged lowland forest suitable for both species). *V. vulgaris* is more common than other species in central Europe (Fig. 4c). This is due to: (i) *D. media* is not as common as in the UK and (ii) many of trapping sites were situated at medium and higher altitudes where *V. crabro* and *V. germanica* are not very

common in forest stands. The results for southern Europe (Fig. 4d) are the most different; the oligoeurythermic species *V. vulgaris* becomes a rare species (see e.g. MADERO MONTERO 1988) while the polyeurythermic species *V. germanica* and *P. dominulus* have an optimum of occurrence (MADERO MONTERO 1988).

Altitudes.

A division of all locations into three altitudinal categories also yields interesting results (Fig. 5). *V. vulgaris* was the most common species in all three groups, but the results vary in its representation and in the numbers of other species. The "lowland" category (0–340 m.a.s.l., 81 localities, Fig. 5a) has very high representation of *V. crabro* (43%) which reaches optimum occurrence in lowland floodplain and oak forests (NIEDL & DENEŠ 1969, SMETANA 2004, DVOŘÁK & ROBERTS 2006). In comparison with the two other groups, the representation of *V. germanica*, which is eurytopic but somewhat sivliphobic, is remarkable (NIEDL & DENEŠ 1969, DVOŘÁK & ROBERTS 2006). *V. germanica* may occur in suitable forests conditions, but it gives preference to lowland floodplain and oak forests, in similar fashion to *V. crabro* (SMETANA 2004). The "medium-high" category (350–740 m.a.s.l., 33 localities, Fig. 5b) is characterised by a higher representation of *V. vulgaris* and lower representation of *V. crabro*. Three species were trapped in the "mountain" category (750–1380 m.a.s.l., 17 localities, Figs 5c, d), but *V. germanica* occurred only at ESP 7. This species reaches optimum occurrence in southern Europe and may also inhabit higher forests there (MADERO MONTERO 1988). For this reason, two figures are shown for the "mountain" category. The situation in other parts of Europe is quite different. If one omits *V. germanica*, there is a 74% prevalence of *V. vulgaris* in mountain regions. *V. vulgaris* is one of the most common species in the mountain forests of central Europe (KUHLMANN 2002, WERSTAK & ZYLA 2005). A relatively high number of *D. media* at higher altitudes (up to 1180 m, GER 3) probably reflects an enthusiastic response to the bait traps on the part of this species.

Forest types.

All the localities studied were divided into three groups according to forest type: coniferous (41 localities), broadleaf (78 localities), and mixed (12 localities). *V. vulgaris* was the absolutely dominant species in coniferous forests (Fig. 6a). This species does actually not prefer this type of forest; the results are influenced by the fact that other species regularly attracted by bait traps evidently prefer other forest types. *V. vulgaris* is one of the two most common species in coniferous forest (KUHLMANN 1999, KULA & TYRNER 2003b, WERSTAK & ZYLA 2005, DVOŘÁK & ROBERTS 2006). The most common species in broadleaf forests was *V. crabro* (Fig. 6b). *V. vulgaris* is also common in broadleaf forests, but the results reflect a very high preference for floodplain and oak forests on the part of *V. crabro* (NIEDL & DENEŠ 1969, SMETANA 2004, DVOŘÁK & ROBERTS 2006). The three wasp species had similar percentage representations in mixed forest (Fig. 6c). The number of *D. media* (30%) is very interesting. Because we studied only 12 mixed forests, we cannot judge if this forest type is the most suitable for *D. media*. Many authors report *D. media* as a forest species without visible preferences,

inhabiting a wide spectrum, from pine and spruce to lowland broadleaf forests (Kuhlmann 1999, 2001, 2002; Shlyakhtenok & Agunovich 2001; Kula & Tyrner 2003a, b; Werstak & Zyla 2005; Dvořák & Roberts 2006).

The results become a little different on dividing the forest types into further categories (mainly monoculture stands). In fact, only *V. vulgaris* and *V. crabro* were trapped in significant numbers in the four alder forests (Fig. 7a). *V. vulgaris* was an eudominant species in 13 beech forests (Fig. 7b), *V. crabro* and *D. media* occurring in significant numbers as well. The most diverse fauna for broadleaf forests were found in the 14 oak forests (Fig. 7c), where the same species as in beech forests were found together with a 4% representation of *V. germanica*. This type of forest is the most suitable for *V. germanica* (see e.g. Smetana 2004). The results from the two main types of coniferous forests are widely different. In total, 77% of wasps in the 22 spruce forests were *V. vulgaris* (Fig. 7d). This reflects the fact that *V. vulgaris* is one of the most common inhabitants of spruce forests (Kuhlmann 1999, 2001, Kula & Tyrner 2003b, Werstak & Zyla 2005, Dvořák & Roberts 2006). The results from 18 pine forests are very interesting, in which all the species mentioned in this paper except *V. velutina* were trapped (Fig. 7e). The total number of wasps is relatively low in this forest type, but pine forests can represent a very suitable biotope for social wasps (see e.g. Shlyakhtenok & Agunovich 2001, Werstak & Zyla 2005).

Humidity.

As was mentioned in previous sections, some wasps prefer drier stands and others prefer the more humid. *V. vulgaris* has the highest percentage representation in mesic forest types (Fig. 8c) together with *D. media*. Niedl & Deneš (1969) wrote that *V. vulgaris* avoids waterlogged forests. This is also the opinion of the author, based on his own observations in SW Bohemia. It is curious that *D. media* proved very rare in humid forests (Fig. 8b, 6 specimens only), because some authors have maintained that *D. media* prefers alluviums and banks of streams (Smetana 2004). or that the species prefers more humid stands (Niedl & Deneš 1969). *V. germanica*, as a typical inhabitant of dry oak forests (Smetana 2004), has the highest representation in dry forests (Fig. 8a). *V. crabro* is the most common species in humid forests (Fig. 8b); it has a marked preference for floodplain forests (Smetana 2004, Dvořák & Roberts 2006). *V. crabro* is also more common in dry forests than in mesic ones (Figs 8a, c) due to its affinity with oak forests (Niedl & Deneš 1969, Smetana 2004, Dvořák & Roberts 2006). Other species occurred in low numbers.

Disturbance.

All locations included in the ALARM field site network were divided into disturbed and undisturbed sites. *V. vulgaris* and *V. germanica* had slightly higher representations in disturbed sites (Fig. 9). Both species are common in secondary stands and in urban areas (Kemper & Döhring 1967, Dvořák & Landolt 2006). However, the differences in our results are too small for evaluation.

code loc.	no	Vcra	Vvel	Vger	Vvul	Vruf	Dmed	Dsax	Pdom	sum
BEL	1	1								1
BEL	2				38	1	1			40
BEL	3			1	26					27
CZE	1	3					4			7
CZE	2	22			17		8			47
CZE	3	42			48					90
CZE	4	1			6		2			9
CZE	5				1					1
CZE	6									0
CZE	7									0
CZE	8	1			2					3
CZE	9				2		1			3
CZE	10						2			2
CZE	11	5			7					12
CZE	12	8			28		6			42
CZE	13	7			59		6			72
CZE	14	14			47					61
CZE	15	2			6					8
CZE	16	9		1	24					34
CZE	17	4			14					18
CZE	18	2			1					3
CZE	19				8					8
CZE	20				4					4
CZE	21				8					8
CZE	22				1					1
CZE	23	8								8
CZE	24				12					12
CZE	25				1					1
CZE	26	7					1			8
CZE	27	41					2			43
CZE	28	12		1	92					105
CZE	29	17			79		1			97
CZE	30	10			10					20
CZE	31	81		5	128		1			215
CZE	32	2			12		6			20
CZE	33	84			24		7			115
CZE	34	3			9					12
CZE	35				3		4			7
CZE	36	1			4		1			6
CZE	37	3			8		1			12
CZE	38				2					2
CZE	39				3		1			4
CZE	40	6			49					55
CZE	41	4			7		3	1		15

Table 1. Wasp numbers from each trapping site in the study. Continued.

code loc.	no	Vcra	Vvel	Vger	Vvul	Vruf	Dmed	Dsax	Pdom	sum
CZE	42				7					7
ESP	1								1	1
ESP	2			1					2	3
ESP	3			1						1
ESP	4								1	1
ESP	5									0
ESP	6			3						3
ESP	7			18	3					21
ESP	8				1					1
ESP	9									0
ESP	10									0
ESP	11									0
EST	1				2					2
EST	2	2			12		1			15
EST	3	3					5			8
EST	4	22			3		7			32
FRA	1	17	1	5			2		2	27
FRA	2									0
FRA	3	5			5					10
GER	1						2			2
GER	2						2			2
GER	3				1		4			5
GER	4									0
GER	5				1		1			2
GER	6				1					1
GER	7				11		1			12
GER	8						1			1
GER	9	1								1
GER	10	1			2		2			5
GER	11	2			1					3
GER	12	2								2
GRE	1									0
GRE	2									0
GRE	3									0
IRL	1				15					15
IRL	2				52	1				53
ITA	1	14								14
ITA	2	8			3					11
LTH	1	7			11	1	4	1		24
LTH	2			1	2	3	3	1		10
LTH	3	1		2	14	1				18
LTH	4	7		7	6	1	2			23
POL	1	23		1	7					31
POL	2	16		5	8					29
POL	3	9		1	25					35

Table 1. Wasp numbers from each trapping site in the study. Continued.

code loc.	no	Vcra	Vvel	Vger	Vvul	Vruf	Dmed	Dsax	Pdom	sum
POL	4	109		5	71	1	1			187
SVK	1	90			51		19			160
SVK	2	39			16					55
SVK	3	4			41		2			47
SVK	4	1		2	55		1			59
SVK	5	90			18		1			109
SVK	6	56			1					57
SVK	7	2			1					3
SVK	8	37			7		1			45
SVK	9				6		3			9
SVK	10	7			12	1	8			28
SWE	1				4					4
SWI	1	2			2					4
UK	1				20		1			21
UK	2									0
UK	3									0
UK	4				32		4			36
UK	5	127		1	13		14	1		156
UK	6	32			4		7			43
UK	7	4			5		1			10
UK	8	20		1	2					23
UK	9	7			29					36
UK	10	50		9	21		10			90
UK	11	33			18		32			83
UK	12	32		1	13		3			49
UK	13	3			20		2			25
UK	14	3		1	10		3			17
UK	15	2			30		7			39
UK	16	2			7		3			12
UK	17	24		2	24		1			51
UK	18	20		1	12		54	1		88
UK	19	3			3		2			8
UK	20	42		2	7		9			60
UK	21	1			7					8
UK	22	7		1	7					15
UK	23	8			13	1	3			25
UK	24	17		1	30		6			54
UK	25	26		1	13		8			48
UK	26				42		1			43
UK	27	5		4	18		9			36
UK	28	5			20		3			28
UK	29	1		3	11		8			23
SUM		1451	1	88	1699	11	322	4	7	3583

Table 1. Wasp numbers from each trapping site in the study.

Comments on individual wasp species

- ***Vespa velutina* Lepeletier, 1836:** A single specimen was trapped at locality FRA 1 (Table 1). This new member of European wasp fauna (Haxaire et al. 2006) has spread throughout France and now inhabits most of the SW of the country (J. Haxaire, pers. comm.).
- ***Vespa crabro* Linnaeus, 1758:** The second most common species in this study (Figs 2–3, Table 1). It was very common at lower altitudes and rare in higher altitudes (Fig. 5) with a definite preference for broadleaf alder and oak forests (Figs 6–7). *V. crabro* was represented at 55% in humid forests types (Fig. 8). These results agree with published data indicating that the species has its optimum occurrence in lowland floodplain and oak forests (Niedl & Deneš 1969, Smetana 2004, Dvořák & Roberts 2006).
- ***Vespula germanica* (Fabricius, 1793):** Trapped in relatively small numbers (Table 1). This species exhibits a high response to baited traps (Dvořák & Landolt 2006). However, it is somewhat silviphobic (Niedl & Deneš 1969, Dvořák & Roberts 2006) and thus the fourth most common (Figs 2–3). *Vespula germanica* has relatively the highest representation in lowland dry oak and pine forests (Figs 5, 7, and 8). Smetana (2004) mentioned *V. germanica* as a species preferring forest-steppe areas. Most authors (Kemper & Döhring 1967, Madero Montero 1988, Dvořák & Landolt 2006) consider this species ubiquitous, preferring open stands.
- ***V. vulgaris* (Linnaeus, 1758):** The most common species in our study (Figs 2–3, Table 1). As an oligoeurythermic species (sensu Gusenleitner 1975), it is quite rare in southern parts of Europe. Similarly, *V. vulgaris* was represented by only 13% in southern Europe in this study (Fig. 4d). The representation of this species increases with altitude (Fig. 5), a fact based on the predominantly lower numbers of other species, *V. vulgaris* is the most common species in mountainous areas (Kuhlmann 1999, 2001, 2002). The same factor influenced the high representation of this species in coniferous (mainly spruce) forests (Figs 6, 7). The two other species commonly found in coniferous forests (*Vespula rufa* and *Dolichovespula norwegica*) are not easily attracted by bait traps.
- ***Vespula rufa* (Linnaeus, 1758):** Only irregularly taken in baited traps (see also Dvořák & Landolt 2006); only 11 specimens gathered in our study (Table 1). This sum is too small to permit evaluation, but it is interesting that 6 specimens (of only 11 counted) were trapped in Lithuania.
- ***Dolichovespula media* (Retzius, 1783):** The third most common species with 9% (Figs 2–3, Table 1). It has its highest representation in the British Isles and northern Europe (Fig. 4a, b). This is an interesting result for Britain, where *D. media* is a new immigrant (see Dvořák & Roberts 2007 for more information). This species was common in traps at higher altitudes as well (Fig. 5c). *D. media* was the only species with a much higher representation in mixed forests than in coniferous and broadleaf (Fig. 6). This result, among others, is difficult to explain.

Most authors have reported *D. media* as a relatively rare species occurring in various forest types (Niedl & Deneš 1969; Kuhlmann 1999, 2001, 2002; Shlyakhtenok & Agunovich 2001; Kula & Tyrner 2003a, b; Smetana 2004; Werstak & Zyla 2005; Dvořák & Roberts 2006). The varying results may be explained by (i) good response of this species to baited traps and (ii) by a probable significant increase of numbers of *D. media* in Europe.

- ***Dolichovespula saxonica* (Fabricius, 1793)** and ***Polistes dominulus* (Christ, 1791):** Only 5 specimens of the former and 6 of the latter (Table 1) were taken, so evaluation of these species is impossible. Dvořák & Landolt (2006) have reported similarly low numbers of *D. saxonica* trapped in orchards with syrup bait. *P. dominulus* was more common in the results of Dvořák & Landolt (2006) than in this research due the species' silviphobia.

Conclusion

Beer is an attractive bait for several species of social wasps. Trapping with it may be recommended as a part of social wasp research. Only three wasp species (*Vespa crabro*, *Vespula vulgaris*, and *Dolichovespula media*) are regularly trapped with beer in forest ecosystems. Other trapped species are (i) local (*Vespa velutina*), (ii) more or less silviphobic (*Vespula germanica*, *Polistes dominulus*) or (iii) show very low response to bait traps (*Vespula rufa*, *Dolichovespula saxonica*).

Wasp numbers vary over the years, so these results may be partly biased. A second bias involves species of the genus *Dolichovespula* (except *D. media*), which are not regularly attracted to bait and their numbers in the this study do not reflect their real proportion in the general wasp population. The results reflect the situation for *Vespa crabro*, *Vespula germanica*, *V. vulgaris*, and *Dolichovespula media* only. On the other hand, only these four species showed any response to the chemical attractants used in Hungary (Landolt et al. 2007) so beer-baited traps really appear to complement the methodology of social wasp research.

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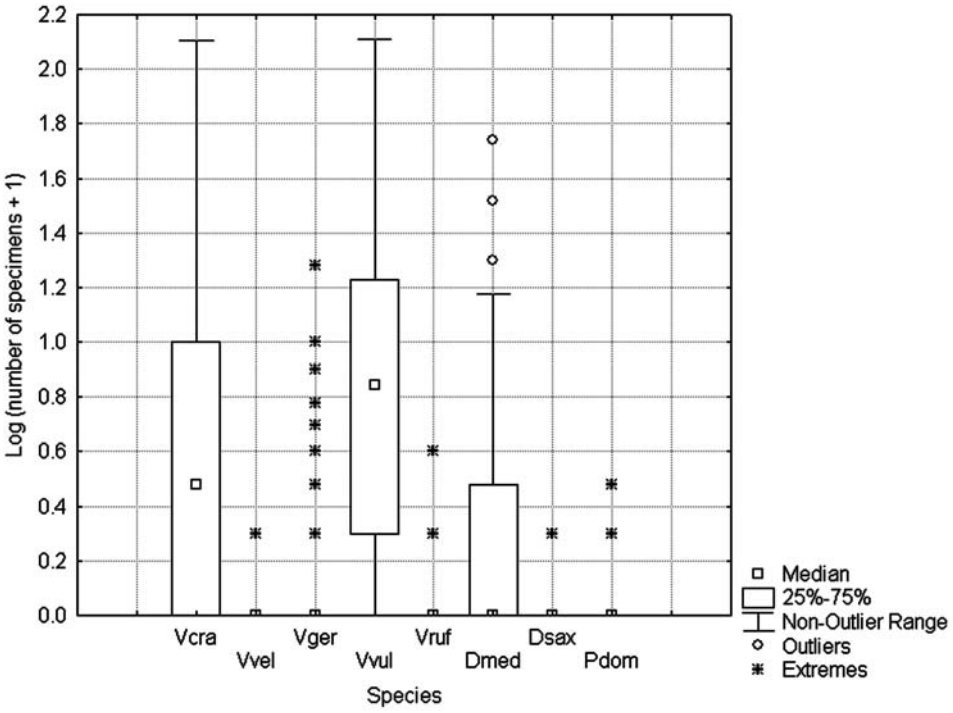

Fig. 2. Variability of abundance of individual species within the samples collected. Original numbers have been log-transformed.

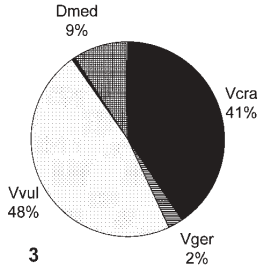

Fig. 3. Wasp representation in the study.

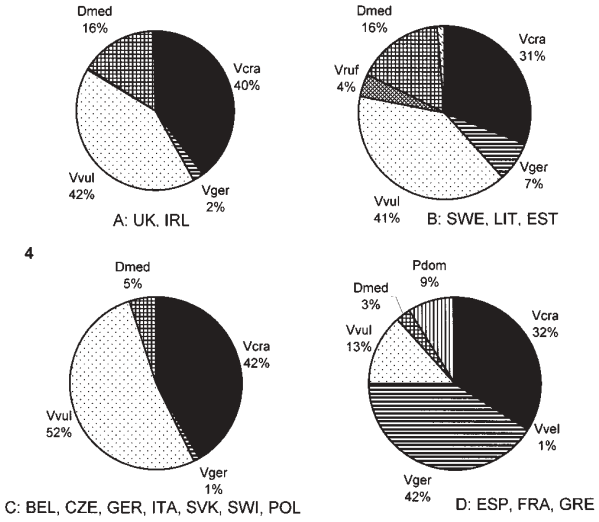

Fig. 4. Wasp representation in the British isles (A), northern Europe (B), central Europe (C), and southern Europe (D).

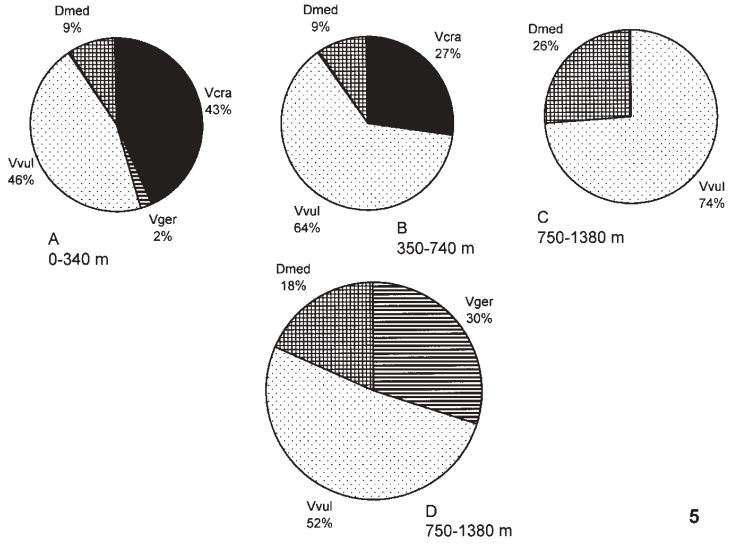

Fig. 5. Wasp representation at lower altitudes (A: 0–340 m), at medium altitudes (B: 350–740), and at mountainous altitudes (C–D: 750–1380 m). Fig. 5D shows all data, Fig. 5C shows reduced data after omitting 18 specimens of Vger from ESP 7.

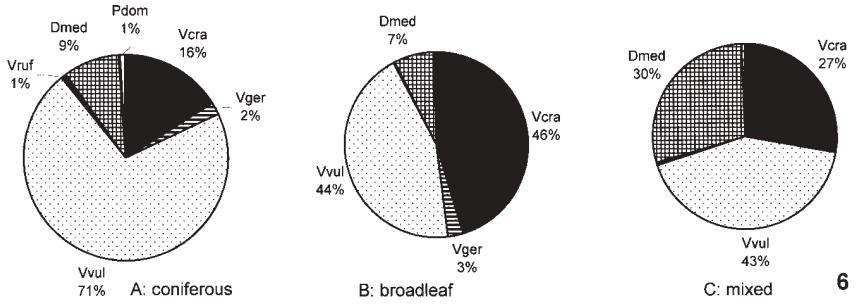

Fig. 6. Wasp representation in coniferous (A), broadleaf (B), and mixed (C) forests.

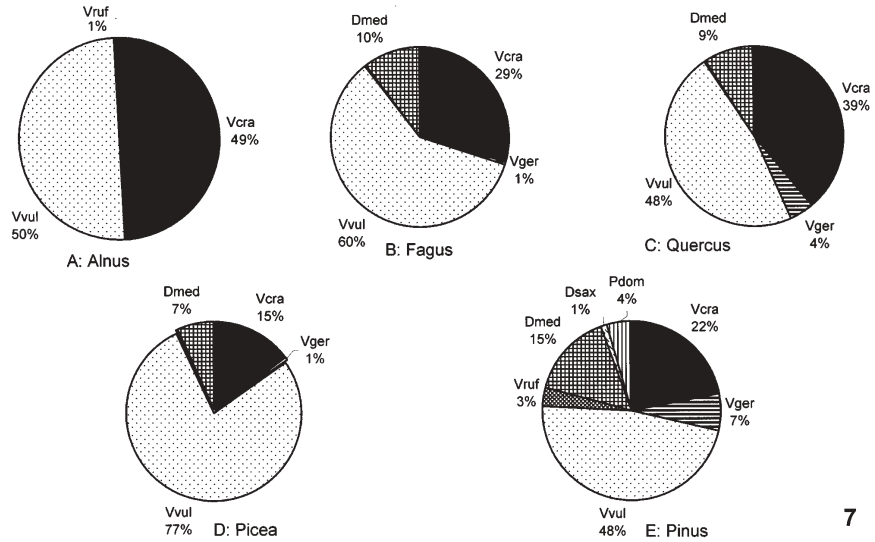

Fig. 7. Wasp representation in alder (A), beech (B), oak (C), spruce (D), and pine (E) forests.

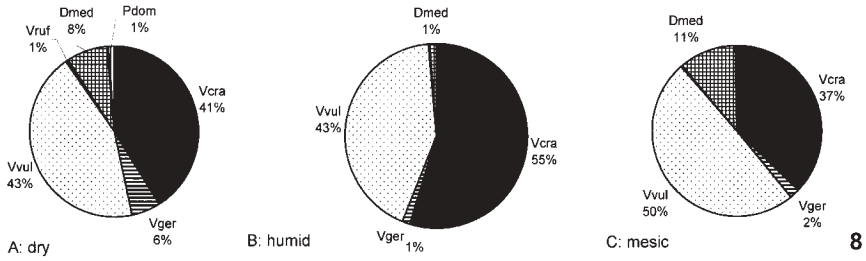

Fig. 8. Wasp representation in dry (A), humid (B), and mesic (C) forest types.

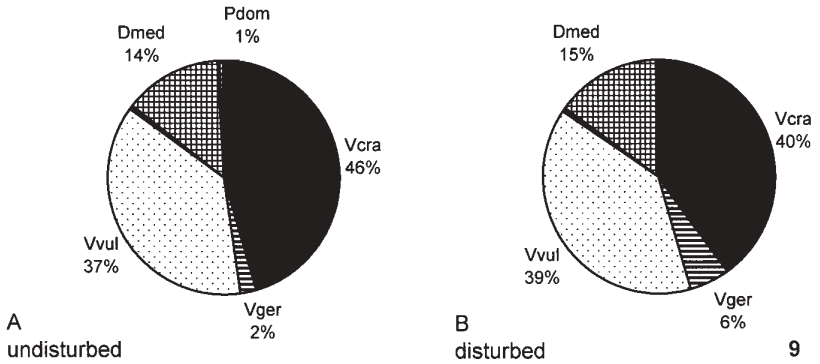

Fig. 9. Wasp representation in disturbed (A) and undisturbed (B) sites.

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