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# The genus *Halictoxenos* Pierce, 1908 (Strepsiptera, Stylopidae) in the Czech Republic and Slovakia

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STRAKA J., MALENOVSKÝ I. & BATELKA J. 2006: The genus *Halictoxenos* Pierce, 1908 (Strepsiptera, Stylopidae) in the Czech Republic and Slovakia. *Acta Musei Moraviae, Scientiae biologicae* (Brno) **91:** 69–82. – Based on a revision of museum material and recent collections, three species of the genus *Halictoxenos* Pierce, 1908 (Strepsiptera: Stylopidae) are recorded from the Czech Republic. They have been identified as *H. arnoldi* Perkins, 1918, *H. spencei* (Nassonov, 1893) and *H. tumulorum* Perkins, 1918. The latter two species were also found in Slovakia. Figures and diagnostic characters are provided for the females of the three species and information is given on their distribution and hosts. In both the countries, *H. arnoldi* has so far been found associated with *Lasioglossum* (*Lasioglossum*) *xanthopus*, *H. spencei* with eight solitary species from the "acarinate" lineage of *Lasioglossum*, subgenus *Evylaeus* and *H. tumulorum* with three species of *Halictus* (all Hymenoptera: Halictidae). *Lasioglossum* (*Evylaeus*) *sabulosum* (Warncke, 1986) and *L.* (*E.*) *sexstrigatum* (Schenck, 1870) are reported as new hosts for *H. spencei*. No morphological changes due to stylopization were observed on any of the examined hosts.

**Key words.** Strepsiptera, Stylopidae, *Halictoxenos*, parasitoids, Hymenoptera, Halictidae, *Lasioglossum*, *Halictus*, Central Europe, distribution, host associations.

## Introduction

The Strepsiptera is a small order of insects consisting of entomophagous parasitoids. They are known to parasitize seven orders and thirty-five families of Insecta (KATHIRITHAMBY 1989). In Central Europe, twenty-one species of Strepsiptera have been found, of which fourteen species are associated with Hymenoptera (POHL & MELBER 1996).

The genus *Halictoxenos* Pierce, 1908 (Stylopidae) is confined to bees of the family Halictidae (the genera *Halictus* Curtis, 1833 and *Lasioglossum* Latreille, 1804) and is widely distributed in the Palaearctic, Nearctic, Afrotropical and Oriental Regions, and Australia (HOFENEDER & FULMEK 1943, KIFUNE 1982, POHL & KINZELBACH 1995, KATHIRITHAMBY & TAYLOR 2005). The European species of *Halictoxenos* were last addressed by KINZELBACH (1978), who summarized information on their hosts, distribution and synonymy, and provided redescriptions and keys for determination. He recognized three species in Europe: *H. arnoldi* Perkins, *H. spencei* Nassonov and *H. tumulorum* Perkins.

Data on the Czech and Slovak Strepsiptera, including *Halictoxenos*, have been scarce. OGLOBLIN (1925), while describing the new species *Halictoxenos nitidiusculus* Ogloblin from Poland, also listed a record of two females from former Czechoslovakia (Bohemia). HOFENEDER & FULMEK (1943) cited *Halictoxenos tumulorum*, parasitic on *Halictus tumulorum*, from Kolín (Bohemia). GÜNTHER (1947) received stylopized material from several Czech hymenopterologists and compiled a list of hosts of Strepsiptera in Czechoslovakia that included eight different species of *Halictus* and *Lasioglossum*. He identified the corresponding Strepsiptera as *Halictoxenos nitidiusculus, H. spencei, H. tumulorum* and *H.* sp. and later reported the first three taxa in the checklist of the Czechoslovak insect fauna (GÜNTHER 1977). Finally, based on information on the hosts but without directly examining the specimens KINZELBACH (1978) associated each of these previously published records with *Halictoxenos arnoldi, H. spencei* or *H. tumulorum*.

Recently, we checked the Günther collection of Strepsiptera deposited in the National Museum, Prague. We also found some other unpublished *Halictoxenos* material in this institution and in the Moravian Museum Brno and collected new material in the field. We report all available information on the Czech and Slovak *Halictoxenos* in this paper.

## Material and methods

In the material section, localities are supplemented by a code number (in parantheses), which refers to the map field of the Central-European grid for mapping flora and fauna (EHRENDORFER & HAMANN 1965, adapted by NOVÁK 1989 and PRUNER & MÍKA 1996). The nomenclature of the hosts (Hymenoptera: Halictidae) is used according to SCHWARZ *et al*. (1996). Jakub Straka identified all the hosts.

For Strepsiptera, we employ the nomenclature and synonymy used by KINZELBACH (1978). The morphological terminology is according to KATHIRITHAMBY (1991). Measurements are given in mm and were made from slide-mounted specimens. Slides were photographed using a digital camera mounted on a microscope, scaled and measured by image analysis (Olympus QuickPHOTO PRO).

The Strepsiptera material is mounted on slides (mostly in Canada Balsam or glycerine-gelatine), conserved dry in the hosts or in ethanol. It is deposited (mostly together with the hosts) in the following collections:

JB . . . . . Jan Batelka private collection, Prague
JS . . . . . Jakub Straka private collection, Prague
MMB . . . . . Moravian Museum, Brno (coll. Strepsiptera)
NMP . . . . . National Museum, Prague (coll. Günther and general collection)

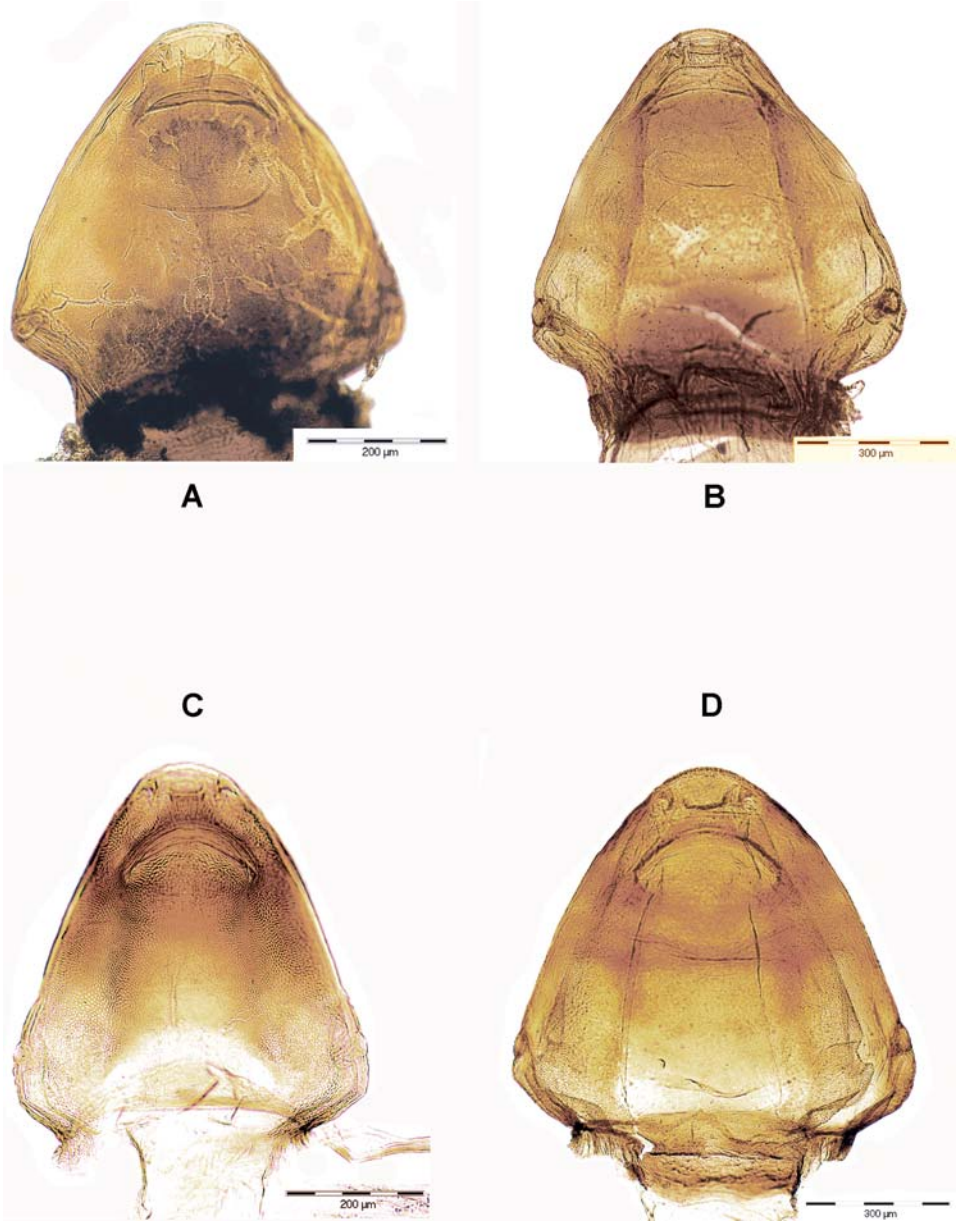



**Fig. 1.** *Halictoxenos* spp., female cephalothorax. A – *H. arnoldi*, Bohemia: Tábor, from *Lasioglossum xanthopus*. B – *H. arnoldi*, Bohemia: Chýnice, from *Lasioglossum xanthopus*. C – *H. tumulorum*, Slovakia: Kamenica nad Hronom, from *Halictus kessleri*. D – *H. tumulorum*, Slovakia: Štúrovo, from *Halictus simplex*.

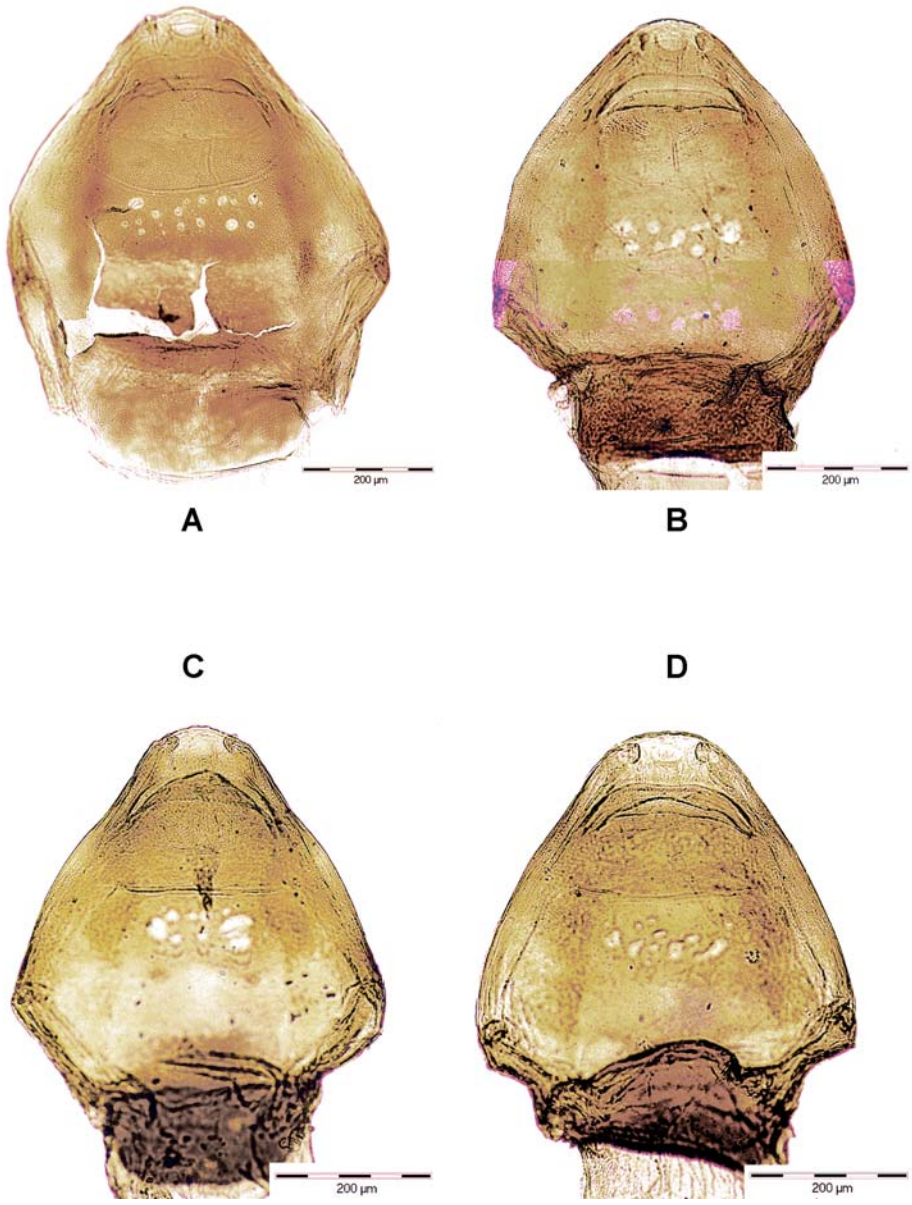



**Fig. 2.** *Halictoxenos spencei*, female cephalothorax. A – Slovakia: Dražovce, from *Lasioglossum limbellum*. B – Moravia: Čejč, from *Lasioglossum nitidiusculum*. C – Moravia: Hradec nad Moravicí, from *Lasioglossum parvulum*. D – Moravia: Bzenec, from *Lasioglossum sexstrigatum*.

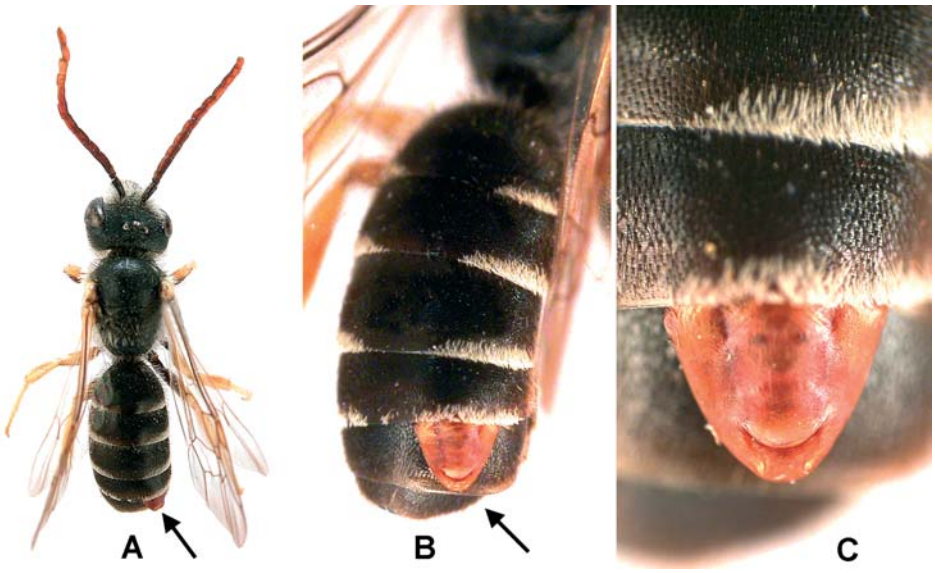



**Fig. 3.** *Halictus simplex* parasitized by *Halictoxenos tumulorum* (Slovakia: Štúrovo). Arrows point at the female cephalothorax extruding exterior of host. A – dorsal view of the host. B – detail of the host abdomen, in dorso-lateral view. C – detail of the cephalothorax of *H. tumulorum*.

## Results

### *Halictoxenos arnoldi* Perkins, 1918 (Figs 1A, B; 4A)

**Material examined. Czech Republic, Bohemia:** Chýnice (6051), 17.iv. (year unknown, second half of the 20th century), 1 ♀, in 1 ♀ *L. xanthopus*, B. Tkalců lgt. (NMP, host dry-mounted, parasitoid on slide); Tábor (6553–54), ix.1939, 2 ♀♀, in 1 ♂ *Lasioglossum xanthopus*, A. Hoffer lgt. (NMP, host dry-mounted, parasitoids on slides).

**Published data.** Günther (1947): 72 (Tábor, as *Halictoxenos* sp. and *H. nitidiusculus*); Kinzelbach (1978): 106, 108 (Tábor, as *H. arnoldi* and *H. spencei*).

**Hosts.** *Lasioglossum* (*Lasioglossum*) *xanthopus* (Kirby, 1802). According to Kinzelbach (1978) probably also associated with other *Lasioglossum* (*Lasioglossum*) spp.: *L. costulatum* (Kriechbaumer, 1873), *L. leucozonium* (Schrank, 1781) and *L. quadrinotatum* (Kirby, 1802).

**Distribution.** Czech Republic, Germany, Great Britain, Hungary and Turkey (Kinzelbach 1978, Pohl 2004). In the Czech Republic so far known only from Central and South Bohemia (Fig. 4A), not yet recorded from Slovakia.

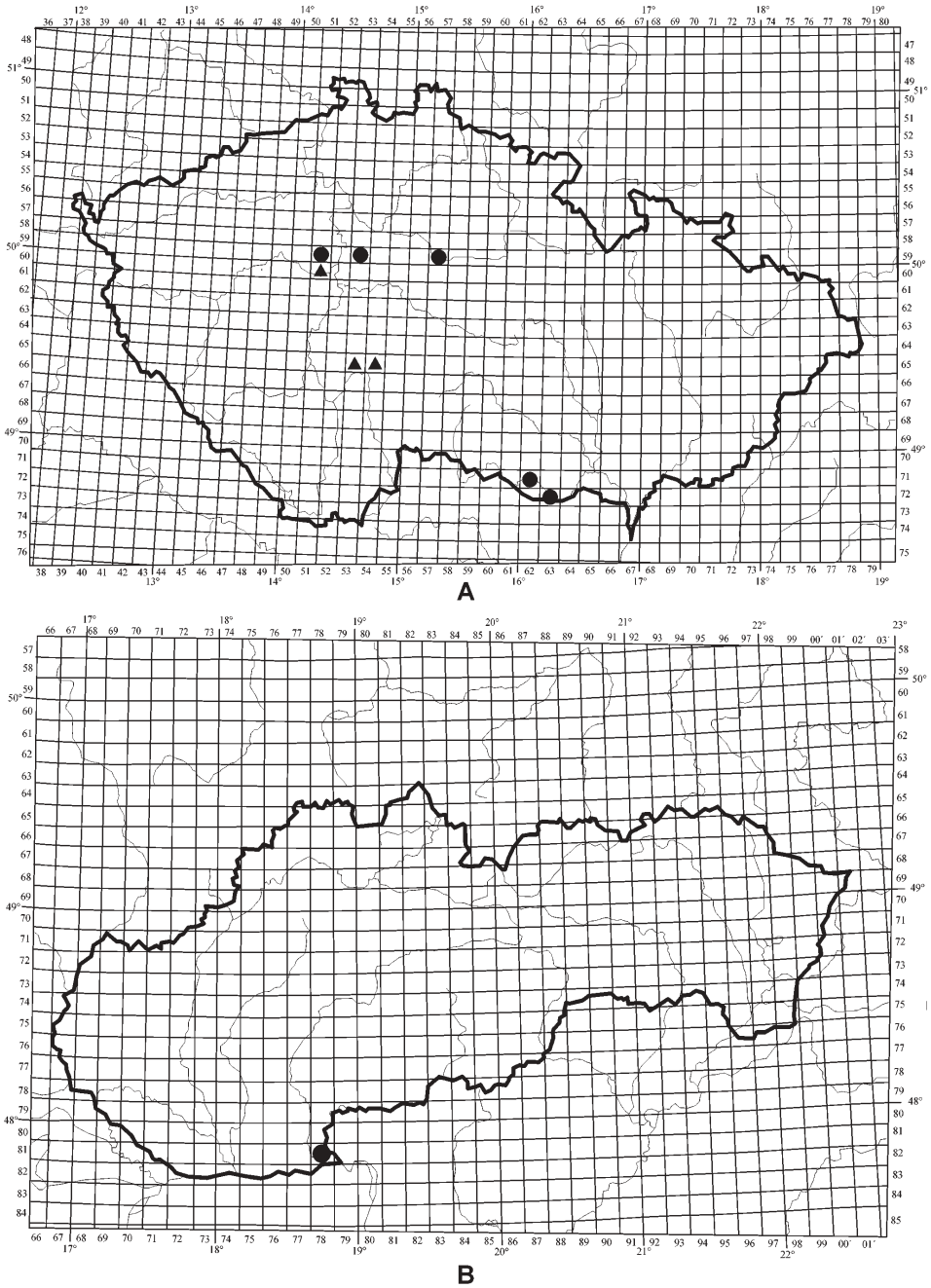



**Fig. 4.** Distribution of *Halictoxenos arnoldi* (black triangles) and *H. tumulorum* (black circles). A – Czech Republic. B – Slovakia.

## ***Halictoxenos spencei* (Nassonov, 1893)** (Figs 2A–D; 5A, B)

**Nomenclatural note:** The original spelling of the specific name is "*spencii*". The subsequent spelling "*spencei*" introduced by KINZELBACH (1969) may be preserved in accordance with ICZN (1999), Art. 33.3.1.

**Synonymy:** *Halictoxenos calceati* Noskiewicz & Poluszyński, 1925; *Halictoxenos cylindrici* Perkins, 1918; *Halictoxenos* (*Halictostylops*) *nitidiusculus* Ogloblin, 1925; *Halictoxenos puncticollis* Noskiewicz & Poluszyński, 1925. See HOFENEDER & FULMEK (1943) and KINZELBACH (1978) for further notes.

**Material examined. Czech Republic, Bohemia:** Bynovec (5151), 28.vi.2005, 1 ♀, in 1 ♀ *Lasioglossum punctatissimum*, coloured pan traps, L. Blažej lgt. (JS, host dry-mounted, parasitoid specimen lost during preparation); Slaný (5750), 15.vi.1923, 1 ♀, in 1 ♀ *Lasioglossum nitidiusculum*, S. Hrabě lgt. (NMP, dry-mounted in host); Praha-Dolní Liboc, Divoká Šárka Nature Reserve (5951), 9.iv.1998, 1 ♀, in 1 ♀ *Lasioglossum parvulum*, M. Kolísko lgt. (JB, dry-mounted in host); Praha-Dubeček (5953), 5.vi.2005, 2 ♀♀, in 1 ♀ *Lasioglossum sabulosum*, observed and collected on *Salvia officinalis* flowers in a garden, in late afternoon at 4 p.m. in cold weather (only *Apis mellifera* Linnaeus, 1758 and *Bombus* sp. were active in the same time), J. Batelka lgt. (JS, in ethanol); Praha-Radotín (6052), 20.iv.1941, 1 ♀, in 1 ♀ *Lasioglossum parvulum*, Píša lgt. (NMP, dry-mounted in host); Zvole, Zvolská homole (6052), 13.v.2006, 18 ♀♀, in 13 ♀♀ *Lasioglossum parvulum* and 2 ♀♀ *Lasioglossum pygmaeum* (1–3 Strepsiptera specimens per host), in hosts' nesting area, in cloudy cold weather, on the ground or in flight, J. Batelka & J. Straka lgt. (JS, in ethanol); Strančice (6054), vi.1949, 3 ♀♀, in 1 ♀ *Lasioglossum parvulum*, V. Kočmíd lgt. (NMP, dry-mounted in host); Písek (6650), 14.vi.1930, 1 ♀, in 1 ♀ *Lasioglossum nitidiusculum*, K. Táborský lgt. (NMP, dry-mounted in host).
**Czech Republic, Moravia:** Hradec (Silesia) [= Hradec nad Moravicí] (6173), 30.iv.1933, 2 ♀♀, in 1 ♀ *Lasioglossum parvulum*, J. Palásek lgt. (NMP, host dry-mounted, parasitoids on slides); Tišnov (6664), 21.iv.1936, 3 ♀♀, in 2 ♀♀ *Lasioglossum parvulum*, A. Hoffer lgt. (NMP, dry-mounted in host); Brno-Bystrc (6765), 5.v.1943, 2 ♀♀, in 1 ♀ *Lasioglossum nitidiusculum*, J. Šnoflák lgt. (MMB, dry-mounted in host); Velehrad (6870), 5.viii.1940, 1 ♀, in 1 ♀ *Lasioglossum villosulum*, V. Zavadil lgt. (NMP, host dry-mounted, parasitoid on slide); Pouzdřany (7065), 8.vii.1938, 2 ♀♀, in 1 ♂ *Lasioglossum nitidiusculum*, V. Zavadil lgt. (NMP, dry-mounted in host); ibid., 13.vii.2005, 1 ♀, in 1 ♀ *Lasioglossum villosulum*, in a vineyard, collected running on the ground, in cold and humid weather at 6 p.m.; P. Bogush & J. Straka lgt. (JS, in ethanol); ibid., 24.iv.2006, 1 ♀, in 1 ♀ *Lasioglossum punctatissimum*, coloured pan traps, J. Batelka & J. Straka lgt. (JS, in ethanol); Čejč u Hodonína (7067), 7.ix.1941, 1 ♀, in 1 ♀ of *Lasioglossum nitidiusculum*, V. Zavadil lgt. (NMP, host dry-mounted, parasitoid on slide); ibid., v.1941, 3 ♀♀, in 2 ♀♀ *Lasioglossum nitidiusculum*, collector unknown (NMP, hosts dry-mounted, parasitoids on slides); Hovorany (7067–68), 29.vi.1944, 2 ♀♀ and first instar larvae, in 1 ♀ *Lasioglossum nitidiusculum*, O. Šustera lgt. (NMP, host dry-mounted, parasitoids on slides); Bzenec (7069), 6.vii.1942, 2 ♀♀, in 1 ♀ of *Lasioglossum sexstrigatum*, O. Šustera lgt. (NMP, host dry-mounted, parasitoids on slides); Dolní Dunajovice (7165), 6.v.2006, 1 ♀, in 1 ♀ *Lasioglossum nitidiusculum*, swept from *Stellaria media* in a vineyard, at 1 p.m., in sunny weather, J. Straka lgt. (JS, in ethanol); Dolní Věstonice (7165), 12.vi.2006, 1 ♀, in 1 ♀ *Lasioglossum pygmaeum*, on *Bryonia alba* flower, at 10 a.m., in sunny weather, J. Straka lgt. (JS, in ethanol).
**Slovakia:** Dražovce near Nitra (7674), 25.viii.1948, 1 ♀, in 1 ♀ *Lasioglossum limbellum*, O. Šustera lgt. (NMP, host dry-mounted, parasitoid on slide); Parkan [= Štúrovo] (81–8278), 7.vii.1946, in 1 ♂ *Lasioglossum nitidiusculum*, O. Šustera lgt. (NMP, dissected host preserved dry, parasitoid not found)..

**Published data.** OGLOBLIN (1925): 116 (Slaný, as *H. nitidiusculus*); GÜNTHER (1947): 72 (Hovorany, Velehrad, as *H. spencii*; Čejč, as *H. nitidiusculus*; Parkáň, Radotín, as *Halictoxenos* sp.), KINZELBACH (1978): 108–109 (Slaný, Čejč, Hovorany, Velehrad; Písek, Pouzdřany – the latter two localities misspelled as "Přseg" and "Przdwiany", as *H. spencei*; Parkáň, Radotín, as *H. spencei* or *H. tumulorum*). Based on our examination of the Günther specimens and their labels, the record of *H. spencei* from *L. nitidiusculum*, Bohemia: Tábor listed by GÜNTHER (1947) is a mistake and refers to *H. arnoldi* and *Lasioglossum* (*L.*) *xanthopus*, respectively. The hosts of the *Halictoxenos spencei* specimens from Velehrad published by GÜNTHER (1947) as *Halictus minutus* [= *Lasioglossum parvulum*] and from Parkáň as *Halictus convexiusculus* [= *Lasioglossum convexiusculum* (Schenck, 1853)] were both misidentified and belong to *Lasioglossum villosulum* and *Lasioglossum nitidiusculum*, respectively. The specimens of *Halictus morio* [= *Lasioglossum morio* (Fabricius, 1793)] and *Halictus viridiaeneus* [= *Lasioglossum aeratum* (Kirby, 1802)] from Radotín which GÜNTHER (1947) and

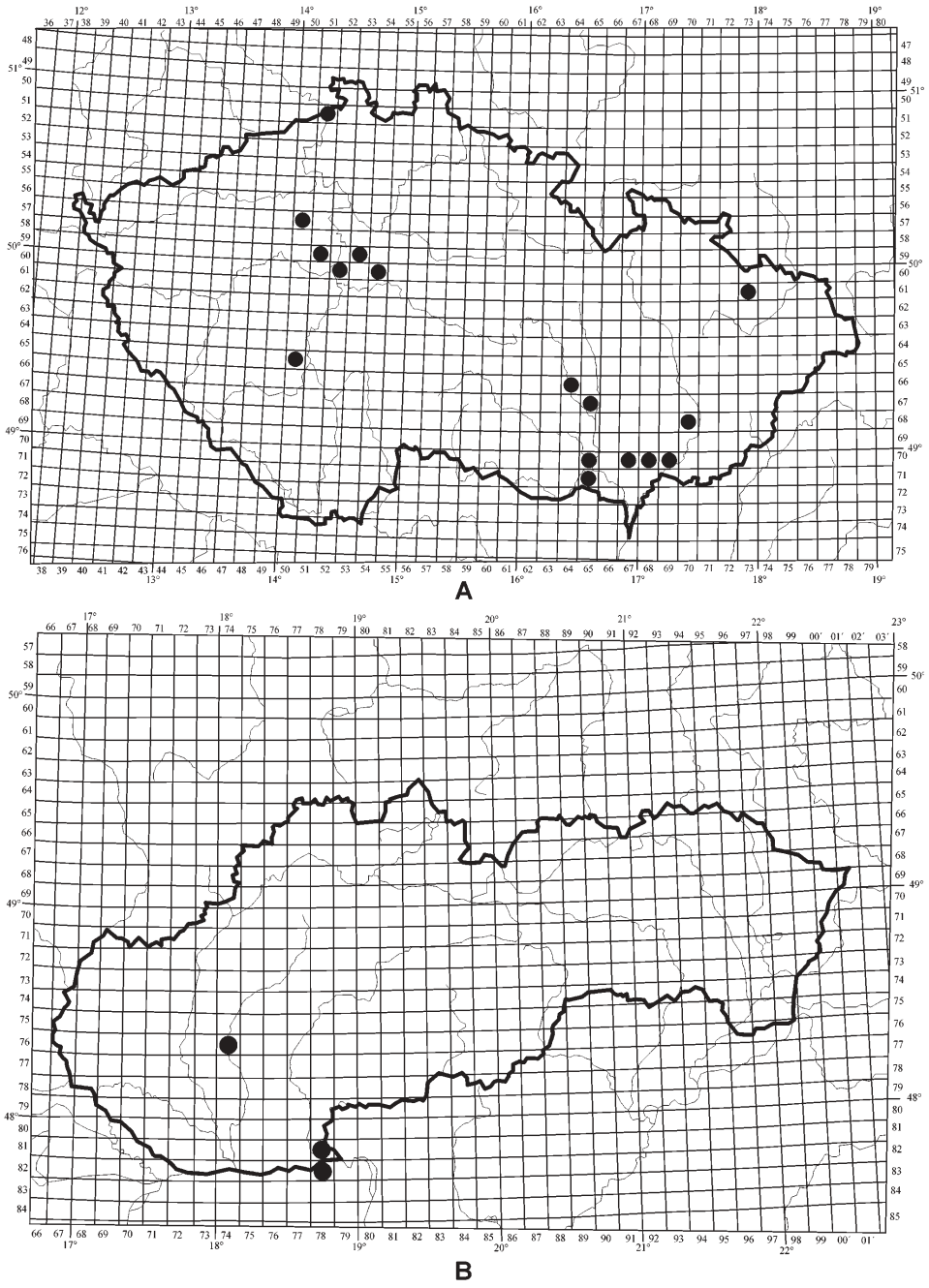



**Fig. 5.** Distribution of *Halictoxenos spencei* (black circles). A – Czech Republic. B – Slovakia.

KINZELBACH (1978) had referred to were also found in the Günther collection in NMP and checked by us. However,we failed to find any traces of their stylopization.

**Hosts.** Restricted to the subgenus *Evylaeus* Robertson, 1902 of the genus *Lasioglossum*. In the Czech Republic and Slovakia so far recorded from *Lasioglossum* (*Evylaeus*) *limbellum* Morawitz, 1876; *L.* (*E.*) *nitidiusculum* (Kirby, 1802); *L.* (*E.*) *parvulum* (Schenck, 1853); *L.* (*E.*) *punctatissimum* (Schenck, 1859); *L.* (*E.*) *pygmaeum* (Schenck, 1853); *L.* (*E.*) *sabulosum* (Warncke, 1986); *L.* (*E.*) *sexstrigatum* (Schenck, 1870); *L.* (*E.*) *villosulum* (Kirby, 1802). *L.* (*E.*) *sabulosum* and *L.* (*E.*) *sexstrigatum* are reported as the hosts of *Halictoxenos spencei* for the first time. For a full list of confirmed and unconfirmed hosts see KINZELBACH (1978).

**Distribution.** Widely distributed in the western Palaearctic region. Reported from Austria, Belgium, Great Britain, Canary Islands, Czech Republic, Denmark, Finland, France, Germany, Greece (mainland and Crete), Hungary, Ireland, Italy (including Sardinia), Norway, Poland, Slovakia, Spain, Ukraine, and Turkey (KINZELBACH 1978, POHL 2004, BATELKA & STRAKA 2005, RONAYNE & O'CONNOR 2006). Distribution in the Czech Republic and Slovakia is shown in Fig. 5A, B.

### ***Halictoxenos tumulorum* Perkins, 1918** (Figs 1C, D; 3; Fig. 4A, B)

**Synonymy:** *Halictoxenos rubicundi* Noskiewicz & Poluszyński, 1924; *Halictoxenos sajoi* Noskiewicz & Poluszyński, 1924; *Halictoxenos simplicis* Noskiewicz & Poluszyński, 1935; *Halictoxenos ulrichi* Hofeneder, 1939.

**Material examined. Czech Republic, Bohemia:** Praha-Stodůlky (5951), 21.viii.–9.ix.2005, 1 ♀, in 1 ♀ *Halictus tumulorum*, coloured pan trap, J. Straka lgt. (JS, in ethanol)**.** Praha-Dubeček (5953), 18.iv.–25.iv.2006, 1 ♀, in 1 ♀ *Halictus tumulorum*, coloured pan trap, J. Batelka lgt. (JS, in ethanol); ibid., 25.iv.–4.v.2006, 2 ♀♀, in 1 ♀ *Halictus tumulorum*, coloured pan traps, J. Batelka lgt. (JS, in ethanol); ibid., 7.viii.–14.viii.2006, 1 ♀, in 1 ♀ *Halictus tumulorum*, coloured pan trap, J. Batelka lgt. (JS , in ethanol).
**Czech Republic, Moravia:** Tasovice (7162), 24.vi.2006, 18 ♀♀, in 14 ♀♀ *Halictus kessleri* (1–3 Strepsiptera specimens per host), swept from *Berteroa incana*, J. Batelka & J. Straka lgt. (JS, in ethanol); Jaroslavice (7263), 28.iv.2006, 3 ♀♀, in 2 ♀♀ *Halictus kessleri*, swept from *Erysimum* sp., J. Straka lgt. (JS, in ethanol).
**Slovakia:** Kamenica nad Hronom (8178), 22.vi.1946, 2 ♀♀, in *Halictus kessleri*, Šustera lgt. (NMP, host dry-mounted, parasitoids on slides); Štúrovo, soutok Hronu s Dunajem (8178), 27.vii.1974, 1♀, in 1 ♂ *Halictus simplex*, B. Tkalců leg. (JS, host dry-mounted, parasitoid on slide).

**Published data.** HOFENEDER & FULMEK (1943): 34 (Kolín, as *H. tumulorum*); GÜNTHER (1947): 72 (Kolín, as *H. tumulorum*, Kamenica nad Hronom, as *H.* sp.), KINZELBACH (1978): 106, 108 (Kolín, Morawa, Kamenica nad Hronom, as *H. tumulorum*). The host of the *Halictoxenos* specimen from Kamenica nad Hronom published by GÜNTHER (1947) as *Halictus subauratus* (Rossi, 1792) was misidentified and belongs to *H. kessleri*. We have not found the specimens of *H. tumulorum* from Kolín (HOFENEDER & FULMEK 1943, GÜNTHER 1947) and "Morawa" [= Moravia ?] (Günther in litt., KINZELBACH 1978) in NMP; these records thus remain unchecked.

**Hosts.** In the Czech Republic and Slovakia found to date ony in *Halictus* (*Seladonia*) *kessleri* Bramson, 1879, *H.* (*S.*) *tumulorum* (Linnaeus, 1758) and *H.* (*Halictus*) *simplex* Blüthgen, 1923. According to KINZELBACH (1978), parasitizes a wide range of species from the subgenera *Halictus* and *Seladonia* Robertson, 1918 of the genus *Halictus* and perhaps also some species of *Lasioglossum* (*Evylaeus*).

**Distribution.** Widely distributed in the western Palaearctic region. Reported from Austria, Great Britain, Canary Islands, Czech Republic, Finland, France, Germany, Hungary, Ireland, Italy, Netherlands, Portugal, Russia (NW European part), Slovakia, Spain, Ukraine, Turkey, and North Africa (Kinzelbach 1978, Pohl 2004, Smit & Smit 2005, Ronayne & O'Connor 2006). In the Czech Republic so far found in the warm regions of Central Bohemia and South Moravia. It has also been recorded from southern Slovakia (Fig. 4A, B).

## Discussion

A taxonomic study of the European *Halictoxenos* is difficult because males are scarce. Facultative parthenogenesis has been mentioned as a possible means of reproduction (Kinzelbach 1978). Males have been described so far only in *H. spencei* and *H. tumulorum* (including *H. ulrichi*, a synonym of *H. tumulorum*; for the descriptions of males see Kinzelbach 1978). The descriptions of *H. arnoldi*, as well as several other taxa that are currently treated as synonyms, are based only on females (Perkins 1918a, b, Ogloblin 1925, Noskiewicz & Poluszyński 1924, 1935). Furthermore, all the specimens examined from the Czech Republic and Slovakia are females. Females of Strepsitera, suborder Stylopidia, are neotenic and being devoid of many adult features (e.g. wings, antennae, legs and external genitalia) they are often difficult to identify down to species. Moreover, their size varies according to the size of the host (Kathirithamby 1989). The measurements of our specimens indeed did not yield any help for identification purposes since the morphometric characters largely overlap in all the three species (Tables 1–2). The outline of the cephalothorax is more or less constant within a species, even if it is also subject to a certain variation (Figs 1–2). *H. tumulorum* can be differentiated from *H. arnoldi* and *H. spencei* by the regularly arcuate brood passage opening and lack of pale to translucent spots medially on the cephalothorax forward of an imaginary line connecting the spiracles. These spots correspond to the openings of Nassonov's pheromone glands (Kinzelbach 1978). In *H. tumulorum* the Nassonov glands are distinct as a pair of pale oblong fields at the cephalothorax base on each side of the midline, behind the spiracles. In contrast, both *H. arnoldi* and *H. spencei* share a slightly angular brood passage opening and several (ca. 9–15) small irregular Nassonov gland spots in the middle of cephalothorax forward of the line connecting the spiracles. These spots are translucent and very the distinct on all specimens of *H. spencei* examined, whereas they are more difficult to observe in *H. arnoldi*. Contrary to Kinzelbach (1978) and in agreement with the original description (Perkins 1918b), we were able to locate a series of spots (slightly paler than the rest of cephalothorax) in the middle of cephalothorax in two out of the three *Halictoxenos* specimens from *Lasioglossum xanthopus* studied. Morphological characters be useful for the identification of *H. arnoldi, H. spencei* and *H. tumulorum* are summarized in Table 3. A more detailed study of the systematics of the genus (including relationships to non-European species), based only on female morphology, is probably impossible due to the

| Species | *N* | CL | CW | MW | BW | AW |
|---|---|---|---|---|---|---|
| *arnoldi* | 3 | 0.54–0.88 | 0.57–0.85 | 0.08–0.09 | 0.21–0.25 | 0.38–0.57 |
| *spencei* | 12 | 0.47–0.69 | 0.44–0.70 | 0.07–0.12 | 0.17–0.31 | 0.28–0.58 |
| *tumulorum* | 3 | 0.57–0.82 | 0.51–0.83 | 0.08–0.14 | 0.18–0.30 | 0.36–0.57 |

**Table 1.** Measurements of *Halictoxenos* spp., females. *N* – number of measured specimens. CL – cephalothorax length (from cephalothorax apex to abdomen base). CW – cephalothorax maximum width. MW – distance between the mandibles. BW – brood passage opening width. AW – abdomen base width.

| Species | *N* | CL/CW | BW/CW | AW/CW |
|---|---|---|---|---|
| *arnoldi* | 3 | 0.93–1.04 | 0.29–0.38 | 0.66–0.74 |
| *spencei* | 12 | 0.99–1.29 | 0.38–0.45 | 0.58–0.94 |
| *tumulorum* | 3 | 0.98–1.14 | 0.36–0.40 | 0.68–0.72 |

**Table 2.** Ratios of *Halictoxenos* spp., females. See the key to Table 1 for explanations.

| Species | Cephalothorax shape | Brood passage opening | Pale spots on cephalothorax (Nassonov's gland fields) | Hosts |
|---|---|---|---|---|
| *arnoldi* | posterior edges ± sharply angular | slightly angular | numerous hardly distinct small spots situated medially and forward of an imaginary line connecting the spiracles | *Lasioglossum xanthopus*; ?other *Lasioglossum* (*Lasioglossum*) spp. |
| *spencei* | posterior edges ± obtusely angular | slightly angular | numerous clearly distinct small spots situated medially and forward of an imaginary line connecting the spiracles | *Lasioglossum* (*Evylaeus*) spp. |
| *tumulorum* | posterior edges ± narrowly rounded | regularly arcuate | two large oblong spots situated on each side of the midline at the cephalothorax base behind an imaginary line connecting the spiracles | *Halictus* spp.; ?*Lasioglossum* (*Evylaeus*) spp. |

**Table 3.** Diagnostic characters of females of European *Halictoxenos* spp.

lack of other observable characters. A study of molecular characters would certainly be one of the best approaches to this problem.

The records from the Czech Republic and Slovakia would suggest that *Halictoxenos tumulorum* is restricted to the genus *Halictus*. Kinzelbach (1978) listed also some species of *Lasioglossum* (*Evylaeus*) as being hosts of *H. tumulorum*, among them also *Lasioglossum* (*Evylaeus*) *limbellum*. The female Strepsiptera specimen from *L.* (*E.*) *limbellum* we examined from Slovakia, however, clearly corresponds to *Halictoxenos spencei* (Fig. 2A). *L.* (*E.*) *limbellum* as well as all the remaining Czech and Slovak host bees of *H. spencei* belong to the "acarinate" lineage within the subgenus Evylaeus, which is treated as a secondary solitary group by Danforth *et al.* (2003). Besides the "acarinate" species, several species from the "carinate" group of *Evylaeus* [e.g. *L. calceatum* (Scopoli, 1763), *L. fulvicorne* (Kirby, 1802) and *L. pauxillum* (Schenck, 1853)] can also be parasitized by *H. spencei* (Perkins 1918a, Noskiewicz & Poluszyński 1924, Kinzelbach 1978). These "carinate" species are primarily eusocial but each of them may be polymorphic in degree of social behaviour, up to solitariness (Richards 2000). The only known host of *Halictoxenos arnoldi* in the Czech Republic has so far been *Lasioglossum* (*Lasioglossum*) *xanthopus*. This species seems to be the main host of *H. arnoldi* in Germany as well (Saure 2003).

Specimens of Hymenoptera parasitized by Strepsiptera often show morphological changes due to the effects of the parasitoid on the host. In some characters (e.g. face maculation, antenna segmentation, form and length of hairs on legs and abdomen) stylopized males tend to resemble normal females and stylopized females resemble normal males. These morphological modifications and "intersexual" specimens have been well-documented in stylopized bees from the genus *Andrena* Fabricius, 1775 and some solitary vespids and digger wasps (Pérez 1886, Pierce 1909, Salt 1927, 1931, Kathirithamby 1989). In contrast, we observed no such modifications of secondary sexual characters on any of the host specimens of *Halictus* and *Lasioglossum* parasitized by *Halictoxenos* and examined by us.

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