

Aphis holoenotherae sp. n. an European sibling
of the Nearctic
Aphis oenotherae Oestlund (Hemiptera: Aphididae)

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Introduction

Aphis oenotherae Oestlund, 1887 is reported to be the only species, specifically associated with *Oenothera* herbs (*Onagraceae*) in Europe (BLACKMAN & EASTOP, 2000; 2006). It is Nearctic species claimed to have been introduced to Europe at the end of the last century (HILLE RIS LAMBERS, 1971; SZELEGIEWICZ, 1976; MÜLLER, 1974).

Recently, holocyclic clones of *A. oenotherae* have been reported from Poland (RAKAUSKAS, 2000) and Lithuania (RAKAUSKAS, 2004). An extensive morphometric analysis of the aphid material from various sources, together with the detailed morphological, life cycle, host specificity and molecular studies of holocyclic clones of *Aphis* sp. monoecious on *Oenothera* in Lithuania revealed the existence of a new species inhabiting *Oenothera* in Europe. The aim of this paper is to present the description and discuss the taxonomic status of the new species.

Material and methods

511 apterous, 325 alate viviparous females, 15 fundatrices, 58 oviparae and 44 males were used in this study, comprising 60 field samples originating from 14 countries and 6 clones from Lithuania (Tab. 1.). Twenty six morphological

characters were measured or counted in most cases, preferably those commonly used in the keys (Tab. 2.). When giving the diagnosis of the new species, additional characters were checked that are usually mentioned when describing species in the genus *Aphis* (e.g. STROYAN, 1984; HEIE, 1986). Measurements were performed by means of Carl Zeiss microscope ocular micrometer and exploiting interactive measurement system Micro-Image (Olympus Optical Co. GmbH). All calculations were made by STATISTICA for WINDOWS 5.5 version software (STATSOFT, 2000).

A mixture of specimens that emerged out of four fundatrices in Skirgiškės, Vilnius region of Lithuania in 2006 (clone G in Tab. 1.) was used as a type series when describing the new species, *A. holoenotherae*. Information on the host plants was taken from the labels or identified in the field with the use of ROSTANSKI *et al.* (2004) key. Host plants of the samples collected by K. Rostanski were identified by him. Distribution data of the host plants and synonymy of plant names are in accordance with ROSTANSKI *et al.* (2004).

Results

Aphis holoenotherae sp. n. (Tab. 3-5.)

Apterous viviparous female (14 specimens)

Morphological characters

(A lengths in mm, mean \pm s.d. in parentheses). Dorsum membranous, reticulation frequently visible on margins of thorax, also first and second tergites of abdomen, laterally. Abdomen with marginal tubercles on tergites I and VII only. Basal diameter of tubercle on segm. VII is 0.10 – 1.77 (1.36 ± 0.17) of the basal diameter of antennal segment III. The length of the marginal hair on abdominal segm. I is the 0.92-1.67 (1.31 ± 0.22) of the height of the tubercle on the same segment. Tergite VIII mostly with 2, rarely 3 hairs. Antennae mostly six, occasionally 5 segmented, 0.33-0.50 (0.41 ± 0.05) of the body length. Processus terminalis 1.49-2.28 (1.91 ± 0.22) of the base of the same segment. Secondary rhinaria absent from all antennal segments. Longest hair on antennal segm. III 0.93-1.45 (1.18 ± 0.14) of the basal diameter of antennal segment III. Rostrum reaching to the hind coxae, sometimes to the distal part of hind coxae. Ultimate rostral segment 1.54-1.97 (1.65 ± 0.11) of the length of the second joint of the hind tarsus, bearing 5-10 (6.64 ± 1.34) accessory hairs. Posterior hair on middle trochanter 0.75-1.10 (0.94 ± 0.11) of the diameter of trochantro-femoral suture. That of the hind leg 0.88-1.06 (1.00 ± 0.05). The longest anterior hair on middle femur 0.58-0.81 (0.69 ± 0.08) of the diameter of trochantro-femoral suture. Siphunculi slightly imbricate, tapering, 0.13-0.16

(0.15 ± 0.01) of the body length, 1.25-1.96 (1.54 ± 0.27) of the caudal length. Middle diameter of siphunculus 0.12-0.24 (0.19 ± 0.03) of the siphunculus length. Cauda with 8-15 hairs (11.43 ± 1.74). Body 1.33-1.96 (1.70 ± 0.18) mm. Colour in life dull green, yellowish green or nearly yellow (especially starved dwarfed specimen), somewhat (rather slightly) pulverulent. Eyes dark red. Antennae, legs, siphunculi and cauda pale. In cleared specimen the entire body, antennae and legs transparent, with the very apex of antennal segm. V, most of the VI, apices of tibiae and tarsi dusky or dark. Siphunculi transparent. Cauda normally pale, but darker than siphunculi.

Alate viviparous female (18 specimens)

Morphological characters

Abdomen with large marginal and postsiphuncular sclerites, cross bars on tergites VI-VII. Cross bar on tergite VIII frequently present, sometimes just as a small spinal spot or even absent (in 2 of 18 specimen studied). Small spinal sclerites are sometimes present on anterior tergites. Abdomen with marginal tubercles on tergites I and VII, one tubercle was also present on tergite VIII in two out of 18 specimen. Basal diameter of tubercle on segm. VII is $0.87-1.42$ (1.10 ± 0.19) of the basal diameter of antennal segment III. The length of the marginal hair on abdominal segm. I is the $1.00-1.56$ (1.27 ± 0.18) of the height of the tubercle on the same segment. Tergite VIII with 2 hairs. Antennae six segmented, $0.47-0.59$ (0.53 ± 0.03) of the body length. Processus terminalis $1.77-2.61$ (2.22 ± 0.25) of the base of the same segment. Antennal segment III has 8-15 (11.11 ± 1.94), IV – 3-7 (4.72 ± 1.13), V – 0-2 (0.33 ± 0.59), VI – 0 secondary rhinaria. Longest hair on antennal segm. III $1.01-1.56$ (1.20 ± 0.15) of the basal diameter of antennal segment III. Siphunculi darker than in apterae, definitely imbricated, slightly tapering, $0.09-0.13$ (0.11 ± 0.01) of the body length, $1.00-1.59$ (1.26 ± 0.17) of the caudal length. Cauda with 6-11 hairs (7.89 ± 1.49). Body $1.41-1.78$ (1.60 ± 0.11) mm. Other characters the same as in apterous viviparous females. Head and thorax black, abdomen dark green in life. Nymphs with slightly powdered head and thorax, also rows of moderate segmental wax stripes on abdominal dorsum. In cleared specimen head and thorax dark brownish. Dorsal sclerotization and cauda brownish. Antennae and siphunculi dark brownish. All legs brownish with hind and middle femora, apices of all tibiae and all tarsi dark brownish.

Fundatrix (4 specimens)

Dorsum membranous, reticulation inconspicuous. Abdomen with marginal tubercles on tergites I and VII exclusively. Basal diameter of tubercle on segm. VII is $1.74-2.23$ of the basal diameter of antennal segment. The length of the

marginal hair on abdominal segm. I is the 0.54-0.67 of the height of the tubercle on the same segment. Tergite VIII with 2 hairs. Antennae 5 segmented, 0.32-0.38 of the body length. Processus terminalis 1.41-1.66 of the base of the same segment. Longest hair on antennal segm. III 0.71-1.13 of the basal diameter of antennal segment III. Rostrum reaching to the distal part of median trochanter. Ultimate rostral segment 1.51-1.68 of the length of the second joint of the hind tarsus, bearing 6-8 accessory hairs. Posterior hair on middle trochanter 0.90-0.95 of the diameter of trochantro-femoral suture. Siphunculi slightly imbricate, tapering, 0.10-0.12 of the body length, 1.04-1.20 of the caudal length. Middle diameter of siphunculus 0.23-0.25 of the siphunculus length. Cauda with 8-11 hairs. Body 1.60-1.81 mm. Other characters similar to those in apterae. Colour in life dull green, slightly pulverulent. Otherwise like apterous viviparous female.

Ovipara (6 specimens)

Morphological characters

Dorsum membranous, reticulation inconspicuous. Basal diameter of tubercle on segm. VII 0.66-0.89 of the basal diameter of antennal segment III. The length of the marginal hair on abdominal segm. I is the 0.60-0.71 of the height of the tubercle on the same segment. Tergite VIII with 2 hairs. Antennae 5 segmented, 0.33-0.36 of the body length. Processus terminalis 1.49-1.92 of the base of the same segment. Longest hair on antennal segm. III 0.64-0.94 of the basal diameter of antennal segment III. Rostrum reaching to the hind coxae. Ultimate rostral segment bearing 5-6 accessory hairs. Siphunculi slightly imbricated, cylindrical, 0.60-0.85 of the body length, 0.67-0.81 of the caudal length. Middle diameter of siphunculus 0.33-0.40 of the siphunculus length. Hind tibiae swollen, bearing 57-91 scent plagues. Cauda with 7-9 hairs. Body 1.09-1.37 mm. Other characters similar to those in apterous viviparous females. Colour in life brownish yellow, slightly pulverulent. Eyes dark red. In cleared specimen the entire body, antennae and legs transparent, with the very apex of antennal segm. V, most of the VI, all legs, siphunculi and cauda dusky or dark. Hind legs, especially tibiae, are definitely darker.

Alate male (4 specimens)

Morphological characters

Abdomen with large marginal sclerites, the postsiphuncular ones are small or large. Spinal sclerites on tergites VI-VIII are sometimes fused into cross bars. Small spinal sclerites present on anterior tergites. Basal diameter of tubercle on segm. VII is 0.52-0.53 of the basal diameter of antennal segment III. The length of the marginal hair on abdominal segm. I is the 1.67-

1.80 of the height of the tubercle on the same segment. Tergite VIII with 2 hairs. Antennae six segmented, 0.71-0.72 of the body length. Processus terminalis 2.56-2.87 of the base of the same segment. Antennal segment III has 21-22, IV – 16-17, V – 10-14, VI – 1 secondary rhinaria. Longest hair on antennal segm. III 1.05-1.25 of the basal diameter of antennal segment III. Ultimate rostral segment 1.45-1.84 of the length of the second joint of the hind tarsus, bearing 6 accessory hairs. Siphunculi darker than in apterae, definitely imbricated, cylindrical, 0.63-0.68 of the body length, 0.86-0.87 of the caudal length. Cauda with 6-8 hairs. Body 1.10-1.26 mm. Colour similar to alate viviparous female.

Molecular data

Our preliminary data show the differences in partial sequences of mitochondrial COI and nuclear EF α 1 (TURČINAVIČIENĖ *et al.*, in preparation) between the American samples of *A. oenotherae* and European material of *A. holoenotherae* sp. n. comparable with those between the two Palaearctic species *A. grossulariae* and *A. schneideri* (TURČINAVIČIENĖ *et al.*, 2006).

Biology.

Tested clones of the new species appeared to be monoecious on *Oenothera* spp. The capability to live on caged *E. adenocaulon* in the absence of any *Oenothera* plants was documented in our transfer experiments in Lithuania. One out of six reared clones was holocyclic, two produced only viviparae and males, two just viviparae and oviparae, one – viviparae exclusively. Out of 14 samples collected in Europe in September or later (Tab. 1.), 5 samples (all from Poland and Lithuania) contained both oviparae and males. Three samples revealed just viviparae and males. Therefore, *A. holoenotherae* is supposed to comprise a mixture of holocyclic, gynocyclic, androcyclic and permanently or facultatively anholocyclic clones. MÜLLER (1974) reported on the permanently anholocyclic clones from Germany, and showed their ability to live on *Godetia hybrida*, *Gaura lindheimeri*, *Epilobium montanum*, *E. angustifolium*, *Clarkia elegans* and *Fuchsia* in transfer experiments. Our material available from Germany (Tab. 1.) appeared to be *A. holoenotherae* in its morphology. Thus, the life cycle of *A. holoenotherae* sp. n. is different from that of *A. oenotherae* which is a holocyclic species, alternating between *Ribes* spp. and herbs of the family *Onagraceae*, including *Oenothera* species (REMAUDIÈRE, 1993; BLACKMAN & EASTOP, 2006).

Phenological history of the holocyclic aphids (06 – G in Tab. 1.) in 2006 in Skirgiškės, Vilnius region (Lithuania, 54°50'26.03"N 25°22'15.29"E) was as follows. Hatching from winter eggs on the overwintered rosettes of *O. biennis* started at the end of April (04.30) coinciding with erection of the leaves of rosette. First mature fundatrices appeared on May 17. First mature specimens of fundatrigeniae generation (mostly apterous, with a very few winged specimens) appeared on May 24. Numbers of winged partenogenetic females inc-

reased dramatically in the following generations due to the overcrowding of colonies and exhausting of the host plants in pot cages. Starting from August, alatae successfully established on the rosettes of the first year specimens of *O. biennis*, both in the pot cages and in the field. The production of first males was detected in pot cages on October 1 and lasted till the deep frosts on November 11. Adult oviparae first appeared on October 22.

In our experiment, colonies are heavily attended by ants (*Lasius niger*, *L. fuliginosus*, *Myrmica rubra*, *Formica cinerea*) that build “ant nests” above aphid colonies, up to 30 cm high above the stem of primrose. SZELEGIEWICZ (1976) has also noted the presence of ants, whilst MÜLLER (1974) reported on the absence of those.

Distribution

For the present, only samples/clones of *Aphis* from *Oenothera* in Lithuania and Poland containing oviparae and/or males might be definitely designated as *A. holoenotherae* sp. n. both by means of their life cycle and morphology (see Tab. 1.). Most of the samples from Lithuania, Belarus, Ukraine, Poland, Germany, Slovakia and Czech Republic might be clearly designated as *A. holoenotherae* in their morphology, together with those from Northern Italy (Salgarèda) and Northern Spain (Leon and Comillas). Other samples from Europe appeared morphologically intermediate between *A. holoenotherae* and *A. oenotherae* in their morphology. Partial sequences of mitochondrial COI and nuclear Efa1 (TURČINAVIČIENĖ *et al.*, in preparation) of all European samples (asterisked in Tab. 1.) appeared closely similar and grouped apart from the Nearctic samples (TURČINAVIČIENĖ *et al.*, in preparation). Molecular data (although introductory for the present) support the probable Palaearctic distribution of the *A. holoenotherae* sp. For the present, coexistence of *A. holoenotherae* and *A. oenotherae* in Europe cannot be rejected making morphological separation of two species rather problematic. Hybridization between the two species in Europe is also likely thus explaining existence of intermediate hybrid morphotypes as was shown for currant inhabiting species of *Aphis* (RAKAUSKAS, 2003). Further complex studies (life cycles, DNA analysis, morphometry) are needed to clarify the situation.

Type material

Holotype: apterous viviparous female mounted in the top right corner of the slide labeled “*Aphis holoenotherae* Rakauskas. Holotype + paratypes. *Oenothera biennis*, 2006.VI.24, Skirgiškės, Vilniaus raj., Lithuania, R. Rakauskas, No 06-G, slide No 1“ in the collection of the Department of Zoology, Vilnius University, Vilnius, Lithuania. Paratypes (the same place, material of the same

clone): 3 apterous viviparous females, same data as holotype; 5 apterous viviparous females and 1 fundatrix, 2006.V.28, No 06-G, slide No 1; 5 apterous viviparous females, 2006.V.28, No 06-G, slide No 2; 3 fundatrices, 2006.V.17, No 06-G; 4 alate viviparous females, 2006.VI.10, No 06-G, slide No 2; 5 alate viviparous females, same data as holotype, slide No 2; 6 alate viviparous females, 2006.VII.09, No 06-G1, slide No 3; 4 alate viviparous females and 1 male, 2006.X.01, No 06-G2, slide No 1; 4 alate viviparous females and 1 male, 2006.X.01, No 06-G2, slide No 2; 4 oviparous females, 2006.X.22, No 06-G2; 2 oviparous females, 2006.XI.02, No 06-G. Paratypes in the collections of the Department of Zoology of the Vilnius University, Institute of Entomology of the Czech Academy of Sciences (Česke Budejovice, Czech Republic), and the British Museum (Natural History) in London.

Taxonomic notes

A. holoenotherae is well separated from its closest relatives, *A. oenotherae* and *A. grossulariae*, in its host specificity and life cycle (monoecious and holocyclic on *Oenothera* in Lithuania and Poland at least), also in partial sequences of mitochondrial COI and nuclear EF α 1 (TURČINAVIČIENĖ *et al.*, in preparation), but is difficult to separate by its morphology. It differs from *A. grossulariae* in lacking marginal tubercles on abdominal tergites II-VI and in relative lengths of antennae and processus terminalis. The most reliable character for separation from *A. oenotherae* is the length of processus terminalis (for details see the key below). Further morphometric analysis of the aphid samples (especially those from Nearctics) combined with the information on their life cycles, host specificity and molecular data would help to find more reliable morphological criteria to separate the new species from *A. oenotherae*.

Key to the European *Oenothera* inhabiting species of the subgenus *Bursaphis*

Apterous viviparous females

- 1 Abdominal segments II-VI mostly with marginal abdominal tubercles. Antennae normally more than 0.5 of the body length. Processus terminalis usually exceeds the basal length of the segment 2.5 times at least. Posterior hair on middle trochanter normally longer than the diameter of trochantro-femoral suture. Holocyclic facultatively heteroecious between *Ribes* spp. and *Onagraceae*, mostly *Epilobium* spp. Only occasionally on *Oenothera*.....*grossulariae* Kaltenbach
- Abdominal segments II-VI mostly without marginal abdominal tubercles. Antennae normally less than 0.5 of the body length. Processus ter-

- minalis usually exceeds the basal length of the segment less than 2.5 times. Posterior hair on middle trochanter normally shorter than the diameter of trochantro-femoral suture.....2
- 2(1) Processus terminalis length (the modal value, calculated from several specimens) is less than 0.2 mm. Monoecious facultatively holocyclic on *Oenothera* in Europe at least*holoenotherae* **sp. n.**
- Processus terminalis length (the modal value, calculated from several specimens) is more than 0.21 mm. Nearctic species, holocyclic facultatively heteroecious between *Ribes* spp. and *Onagraceae*, including *Oenothera* spp. Its presence, host specificity and life cycle in Europe needs further confirmation, the same as its synonymy with *A. neomexicana* Cockerell and Cockerell, 1901.....*oenotherae* Oestlund

Alate viviparous females

- 1 Abdominal segments II-VI mostly with marginal abdominal tubercles. Antennae normally more than 0.6 of the body length. Processus terminalis usually exceeds the basal length of the segment 2.5 times at least. Posterior hair on middle trochanter normally longer than the diameter of trochantro-femoral suture*grossulariae* Kaltenbach
- Abdominal segments II-VI mostly without marginal abdominal tubercles. Antennae normally less than 0.6 of the body length. Processus terminalis usually exceeds the basal length of the segment less than 2.5 times. Posterior hair on middle trochanter normally subequal the diameter of trochantro-femoral suture2
- 2(1) Processus terminalis length (the modal value, calculated from several specimens) is less than 0.22 mm.*holoenotherae* **sp. n.**
- Processus terminalis length (the modal value, calculated from several specimens) is more than 0.23 mm.*oenotherae* Oestlund

Males

- 1 Total number of marginal tubercles on abdominal segments II-VI more than 3. Antennae normally more than 0.8 of the body length. Processus terminalis usually exceeds the basal length of the segment 2.7 times at least.*grossulariae* Kaltenbach
- Abdominal segments II-VI without marginal abdominal tubercles. Antennae normally less than 0.8 of the body length. Processus terminalis usually exceeds the basal length of the segment less than 2.7 times.....2
- 2(1) Processus terminalis length (the modal value, calculated from several specimens) is less than 0,22 mm.*holoenotherae* **sp. n.**
- Processus terminalis length is more than 0,22 mm*oenotherae* Oestlund

Conclusions

1. Two species of the genus *Aphis* closely associated with *Oenothera* plants can be found in Europe: *A. oenotherae* Oestlund and *A. holoenotherae* **sp. n.** They have different life cycles and host plant spectrum, they also differ in partial sequences of mitochondrial COI and nuclear EFa1, although are quite similar in their morphology.
2. Processus terminalis length seems to be the most reliable morphological character when separating between apterous and alate viviparous females, also males of *A. oenotherae* and *A. holoenotherae* for the present (see the key above). Further analysis based on more material from Nearctics should result in more reliable morphological characters enabling proper morphological discrimination between these cryptic species.
3. *A. grossulariae* is not a typical *Oenothera*-feeder in Europe, occurring on the evening primroses only accidentally.

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Table 1. Sample information. Abbreviations: BM(NH) – British Museum (Natural History); DZLU Department of Zoology, Leon University, Spain; DZSU – Department of Zoology, Silesian University, Katowice, Poland; DZVU – Department of Zoology, Vilnius University, Lithuania; IEASCR – Institute of Entomology, Czech Academy of Sciences, České Budějovice; Ba – J. Bašilova; Bar – S. Barbagallo; Bu – S. Buga; Cz – A. Czylok; De – J. C. Deeming; Du – R. Durak; Ea – V. F. Eastop; Ess – O. Essig; Gil – C. P. Gillette HRL – D. Hille Ris Lambers; Ho – J. Holman; Je – A. Jensen; La – G. Lampel; Lee – S. Lee; Ma – J. Martin; Mu – F. P. Müller; Ni – J. M. Nieto Nafria; Pe – N. Perez; Roj – V. Rojanavongse; Ro – K. Rostanski; Sz – H. Szelegiewicz; Sy – J. Sypkens; *O.* – *Oenothera*; fx – fundatrix; ap – aptera; al – alata; ov – ovipara.* – indicates samples/clones that were also used for DNA sequencing (TURČINAVIČIENĖ *et al.*, 2006, TURČINAVIČIENĖ *et al.*, in preparation).

Host plant	Location, region, country, date (collector, deposited at: sample No) [abbreviated in Tables and figures as]	Our morphological identification	Morphs
Labelled as <i>A. oenotherae</i> – Europe			
<i>O. biennis</i>	Bzenec, Moravia, Czech Republic, 04/07/1984 (Ho, IEASCR: 18 726-7) [Bzenec]	nr <i>holoenotherae</i>	16ap12al
<i>O. biennis</i>	Kleinmachnow, Potsdam, Germany, 08/06/1988 (Ho, IEASCR: 20 137) [Potsdam]	<i>holoenotherae</i>	12ap
<i>O. biennis</i>	Berlin, Germany, 07/08/1972 (Mu, BM(NH)) [Berlin]	<i>holoenotherae</i>	3ap3al
<i>O. biennis</i>	Chotin, Slovakia, 25/06/1984 (Ho, IEASCR: 18 512-18) [Chotin]	<i>holoenotherae</i>	16ap10al

<i>O. biennis</i>	Uznam, Swinoujscie, Poland, 15/08/1972 (Sz, IEASCR: 4013; BM(NH): 4013) [Uznam]	nr <i>holootherae</i>	6ap
<i>O. flaemingtona</i>	Katowice, Poland, 19/07/1999 (Ro, DZVU) [Katowice99]	nr <i>holootherae</i>	15ap4al
<i>O. biennis</i>	Zabrze, Katowice, Poland, 27/09/1993 (Du, DZSU: 15) [Zabrze]	<i>holootherae</i>	6ap
<i>O. subterminalis</i>	Przechlebie, Gliwice, Poland, 25/06/2002 (Ro, DZVU: 4-6-7) [Gliwice]	<i>holootherae</i>	26ap1al
<i>O. oakesiana</i>	Gnojno, Lublin, Poland, 27/06/2002, (Ro, DZVU: 5) [Lublin]	<i>holootherae</i>	9ap3al
<i>O. perangusta</i> x <i>biennis</i>	Katowice, Poland, 11/06/2002 (Ro, DZVU: 3) [Katowice02]	<i>holootherae</i>	11ap1al
<i>O. brevihypanthialis</i>	Pruszyn, Siedlce, Poland, 27/06/2002 (Ro, DZVU: 2) [Pruszyn]	nr <i>holootherae</i>	7ap4al
<i>O. biennis</i>	Siedlce, Poland, 26/06/2002 (Ro, DZVU: 1) [Siedlce]	intermediate	10ap1al
<i>O. pseudosuaveolens</i>	Skarżysko Kamienna, Kielce, Poland, 17/07/2000 (Ro, DZVU: 38/20/d) [Kielce]	intermediate	3ap
<i>O. rubricaulis</i>	Dunkowice, Sandomierz, Poland, 21/07/2000 (Ro, DZVU: 52/20) [Sandomierz]	<i>holootherae</i>	9ap7al
<i>O. rubricaulis</i>	Kuźnica Warezińska – Dąbrowa Górnicza, Katowice, Poland, 13/10/2000 (Cz, DZVU) [Dabrowa00]	<i>holootherae</i>	5ap19a-11ov2males
<i>O. sp.</i>	*Czeladź, Katowice, Poland, 18/10/2003 (DZVU: 03-126) [Czeladz03]	<i>holootherae</i>	3ap17al3male
<i>O. biennis</i>	Katowice, Poland, 19/09/2003 (DZVU: 03-111) [Katowice03]	<i>holootherae</i>	8ap
<i>O. rubricaulis</i>	*Kuźnica Warezińska, Dąbrowa Górnicza, Poland, 18/10/2003 (DZVU: 03-125) [Dąbrowa03]	<i>holootherae</i>	3ap9al3ov1male
<i>O. biennis</i>	Czeladź, Katowice, Poland, 30/09/2004 (DZVU: 04-179) [Czeladz04]	intermediate	5ap10al
<i>O. sp.</i>	Sieraków Wlkp., Poznań, Poland, 21/09/2005 (DZVU: 05-137) [Poznan]	intermediate	1ap7al2males
<i>O. casimiri</i>	Druskininkai, Lithuania, 02/08/2002 (Ro, DZVU: 8) [Druskininkai]	<i>holootherae</i>	4ap

<i>O. biennis</i>	Skirgiškes, Vilnius, Lithuania, 03/11/2002 (DZVU: 02-111) [Skirgiskes111]	<i>holoetherae</i>	14ap6al1ov 22males
<i>O. biennis</i>	Antakalnis-Vilnius, Lithuania, 01/07/2002 (DZVU: 02-67) [Antakalnis67]	<i>holoetherae</i>	9ap13al
<i>O. biennis</i>	Antakalnis-Vilnius, Lithuania, 07/07/2002 (DZVU: 02-75) [Antakalnis75]	<i>holoetherae</i>	6ap6al
<i>O. biennis</i>	Skirgikes, Vilnius, Lithuania, 25/09/2002 (DZVU: 02-96) [Skirgiskes96]	<i>holoetherae</i>	4ap5al1ov 1male
<i>O. biennis</i>	Skirgikes, Vilnius, Lithuania, 09/10/2002 (DZVU: 02-108) [Skirgiskes108]	<i>holoetherae</i>	23ap19al3ov 7males
<i>O. biennis</i>	Skirgiškes, Vilnius, Lithuania, clone C, 29/09/-27/10/2002 (DZVU: 02-C) [cloneC]	<i>holoetherae</i>	7ap13al 2males
<i>O. biennis</i>	*Skirgiškes, Vilnius, Lithuania, clone L, 07/07/-19/10/2002 (DZVU: 02-L) [cloneL]	<i>holoetherae</i>	2ap9al4ov
<i>O. biennis</i>	*Naujaneriai, Vilnius, Lithuania, 05/07/2003 (DZVU: 03-103) [Naujaneriai]	<i>holoetherae</i>	10ap7al
<i>O. biennis</i>	Pučkalaukis, Vilnius, Lithuania, 02/06/2004 (Ba, DZVU: 04-20) [Pučkalaukis]	<i>holoetherae</i>	2fx
<i>O. biennis</i>	Skirgiškes, Vilnius, Lithuania, clone E, 19/06/2004 (DZVU: 04-E) [cloneE]	<i>holoetherae</i>	3ap7al
<i>O. biennis</i>	Pervalka, Neringa, Lithuania, 10/07/2004 (DZVU: 04-135) [Pervalka]	nr <i>holoetherae</i>	7ap6al
<i>O. biennis</i>	Družiliai, Švenčionys, Lithuania, 17/06/2003 (DZVU: 03-66) [Družiliai]	<i>holoetherae</i>	9ap7al
<i>O. biennis</i>	Valakampiai-Vilnius, Lithuania, 26/05/2003 (DZVU: 03-1) [Valakampiai]	<i>holoetherae</i>	9fx5ap
<i>O. biennis</i>	*Skirgiškes, Vilnius, Lithuania, clone G, 17/05/-02/11/2006 (DZVU: 06-G) [Type material]	holoetherae	4fx14ap18al 6ov2males
<i>O. biennis</i>	Skirgiškes, Vilnius, Lithuania, clone H, 01/10/-29/10/2006 (DZVU: 06-H) [cloneH]	<i>holoetherae</i>	11al3ov
<i>O. biennis</i>	Skirgiškes, Vilnius, Lithuania, clone E, 29/06/-22/11/2006 (DZVU: 06-E) [clone06E]	<i>holoetherae</i>	9ap2males
<i>O. rubricaulis</i>	Kanev reserve, Cherkasy, Ukraine, 16/06/2006 (DZVU: 06-80) [Kanev]	nr <i>holoetherae</i>	10ap

<i>O. biennis</i>	*Bot. Gardens, Kiev, Ukraine, 13/06/2006 (DZVU: 06-50) [Kiev]	<i>holoenotherae</i>	4ap
<i>O. biennis</i>	Iv'e, Grodna, Belarus, 09/09/2002 (Bu, DZVU: 02-357) [Grodna357]	<i>holoenotherae</i>	6ap2al
<i>O. biennis</i>	Siabryn', Grodna, Belarus, 29/08/2002 (Bu, DZVU: 02-323) [Grodna323]	<i>holoenotherae</i>	3ap9al
<i>O. biennis</i>	*Sn Feliz de las Lavanderas, Leon, Spain, 01/09/2005 (Pe, DZVU: LE-2935) [Leon]	nr <i>holoenotherae</i>	1ap
<i>O. biennis</i>	*Buffon str., Paris, France, 25/06/2004 (DZVU: 04-32) [Paris]	intermediate	9ap10al
<i>Baccharis halimifolia</i>	Comillas, Santander, Cantabria, Spain, 24/05/1981 (Ni, DZLU: S-781) [SantanderB]	nr <i>holoenotherae</i>	4ap3al
<i>O. biennis</i>	Comillas, Santander, Cantabria, Spain, 24/05/1981 (Ni, DZLU: S-777) [SantanderO]	intermediate	8ap
<i>O. stucchii</i>	Salgareda, Trevizo, Italy, 04/09/2000, (Ro, DZVU: 87-20-58) [Trevizo09]	nr <i>holoenotherae</i>	12ap4al
<i>O. stucchii</i>	Salgareda, Trevizo, Italy, 26/08/2000 (Ro, DZVU: 77/20/c) [Trevizo08]	intermediate	14ap1al
<i>O. biennis</i>	Chelsey, London, Great Britain 09/07/1992 (Ma, BM(NH)): 616 [London]	intermediate	15ap2al
<i>O. biennis</i>	Kew gardens, Surrey, Great Britain, 24/07/1992 (Ea, BM(NH)): 19382 [Surrey]	intermediate	9ap1al
<i>O. biennis</i>	Punta Sabbioni, Venezia, Italy, 10/08/1969 (Ea, BM(NH)): 12264 [Venezia]	intermediate	11ap11al
<i>O. stricta</i>	Zafferana Etnea, Sicily, 21/09/1977 (Bar, BM(NH)) [Sicily77]	intermediate	5ap3al
<i>O. erythrosepala</i>	Zafferana Etnea, Sicily, 24/09/1978 (Bar, DZCU) [Sicily78]	intermediate	4ap
<i>O. sp.</i>	Kenfig Burrows Nature Reserve (Mid Glamorgan), Bridgend, Wales, Great Britain, no day/07/1992 (De, BM(NH)): [Wales]	intermediate	10ap6al
Labelled as <i>A. oenotherae</i> outside Europe			
? <i>O. sp.</i>	Upper Crab Creek, Lincoln, Washington, USA, 31/05/2004 (Je, DZVU: 18) [Washington]	<i>oenotherae</i>	1ap1al
<i>Epilobium sp.</i>	*Medicine Bow Nat. Forest, Carbon, Wyoming, USA, 04/07/2004 (Je, DZVU: 12) [Wyoming]	<i>oenotherae</i>	2ap

<i>O. biennis</i>	Pecos, San Miguel, New Mexico, USA, 05/07/2004 (Je, DZVU: 6) [New Mexico]	<i>oenotherae</i>	4ap2al
<i>O. sp.</i>	Berkeley Bot. Gardens, California, USA, 30/10/1963 (HRL, BM(NH)): 153 [CaliforniaB]	<i>oenotherae</i>	10ap2al
<i>O. hookeri</i>	Yosemite Mus. Gardens, California, USA, 05/08/1940 (Ess, BM(NH)): 194 [California Y]	<i>oenotherae</i>	7ap7al
<i>O. biennis</i>	Denver, Colorado, USA, 12/04/1925 (Gil, BM(NH)) [Colorado]	<i>oenotherae</i>	9ap
<i>O. parviflora</i>	Spruce Woods, Manitoba, Canada, 26/07/1973 (Roj, BM(NH)): V-75-26-7 [Manitoba]	<i>oenotherae</i>	3ap3al
<i>O. sp.</i>	Wrightsville Beach, North Carolina, USA, 25/04/1964 (HRL, BM(NH)): 262 [NCarolina]	<i>oenotherae</i>	11ap2al
<i>O. biennis</i>	Toronto Ravine, Ontario, Canada, 31/08/1968 (Sy, BM(NH)): 158 [Ontario]	<i>oenotherae</i>	10ap
<i>O. sp.</i>	Haleakala, Maui, Hawaii, 02/04/1999 (Ma, BM(NH)): 7199 [Hawaii]	intermediate	13ap
<i>O. odorata</i>	Bong Pyong Myon, Pyongchang-Gun, S. Korea, 03/06/1999 (Ho, IEASCR: 99Ho652) [Pyong]	nr <i>oenotherae</i>	12ap10al
<i>O. odorata</i>	Taepu-do island, S. Korea, 18/10/2000 (Ho, IEASCR: 00Ho50) [Daebu]	intermediate	6ap1al
<i>O. odorata</i>	*Dunnae, Kangwon-do, S. Korea, 27/06/2003 (Lee, DZVU) [Dunnae]	intermediate	10ap12al

Table 2. Morphological characters (lengths and numbers) used in the present study.

Character	Abbreviation
lengths (in mm) of	
antenna	anten
antennal segments III-V	ant3-5
articular width of the antennal segment II	awant3
*basal part of the antennal segment VI	base6
body (including cauda)	body
cauda	cauda
hind tibia	htib
longest hair on antennal segment III	lhant3
maximum width of the antennal segment III	want3
*processus terminalis of the antennal segment VI	prt6
second segment of hind tarsus	tars2
siphunculus	siphon
ultimate rostral segment	urs
numbers of	
secondary rhinaria on antennal segments III-VI	rhant3-6
additional hairs on the ultimate rostral segment	hurs
hairs on abdominal segment VIII (tergum)	hterg8
hairs on cauda	hcauda
marginal tubercles on abdominal segments II-VI	mt2-6
marginal tubercles on abdominal segments I and VII	mt1,7
hairs on antennal segment III	hant3
scent plagues on hind tibiae of oviparae	splhtibi

* for fundatrices and oviparae, it was base 5 and prt 5, respectively, because their antennae have five antennal segments only.

Table 3. Morphometric data of apterous viviparous females of *A. oenotherae* (samples from Manitoba and Ontario) and the type series (see Tab. 1.) of *A. holoenotherae* sp. n. from Lithuania (extreme values and mean \pm d. in parentheses). Similar data of *A. grossulariae* from *Epilobium adenocaulon* (after RAKAUSKAS, 1998) and *A. oenotherae* (after PALMER, 1952) are given for comparison. Characters of discriminative value are in bold. Character abbreviations the same as used in Table 2. All lengths in mm.

Character	<i>A. oenotherae</i> our data (n = 14)	<i>A. oenotherae</i> (Palmer 1952: 158)	<i>A. holoenotherae</i> sp. n. (n = 14)	<i>A. grossulariae</i> (n = 20)
siphon	292 – 375 (333 \pm 31)	230-360	190 – 305 (246 \pm 33)	190 – 330 (260 \pm 40)
cauda	187 – 222 (203 \pm 12)	100-140	123 – 190 (162 \pm 17)	150 – 220 (190 \pm 20)
body	1837 – 2237 (1997 \pm 121)	1500-2000	1334 – 1964 (1697 \pm 184)	1230 – 1950 (1510 \pm 210)
urs	142 – 177 (153 \pm 11)	130-150	135 – 159 (150 \pm 8)	130 – 150 (140 \pm 10)
ant3	197 – 276 (232+30)	220-350	143 – 196 (169+18)	110 – 230 (180+40)
ant4	128 – 179 (159 \pm 22)	150-260	72 – 152 (107 \pm 20)	70 – 150 (110 \pm 30)
ant5	115 – 176 (149 \pm 17)	130-200	62 – 129 (95 \pm 16)	90 – 160 (120 \pm 20)
base6	94 – 117 (105 \pm 6)	100-140	61 – 99 (80 \pm 12)	80 – 120 (90 \pm 10)
prt6	209 – 265 (247+15)	230-330	101 – 187 (153+28)	200 – 290 (240+30)
anten	913 – 1155 (1026+85)	1000-1200	523 – 859 (701+100)	640 – 1050 (840+120)
lhant3	29 – 44 (35+5)	40	18 – 28 (23+2)	18 – 32 (24+3)
awant3	21 – 28 (25 \pm 2)		17 – 22 (20 \pm 1)	15 – 21 (19 \pm 2)
tars2	94 – 111 (103 \pm 4)	100-110	73 – 103 (91 \pm 8)	80 – 100 (91 \pm 6)
htibia	835 – 1004 (926 \pm 64)	950	581 – 788 (699 \pm 70)	516 – 846 (707 \pm 95)
hurs	6 – 12 (8.92 1.75)	6	5 – 10 (6.64 1.34)	6 – 8 (6.65 0.81)
mt 2-6	0		0	0 – 6 (2.65 \pm 2.18)
mt 1, 7	4		4	4
hcauda	10 – 16 (13.00 \pm 1.78)		8 – 15 (11.43 \pm 1.74)	8 – 14 (10 \pm 1.81)
hant3	7 – 13 (9.54 \pm 1.76)		4 – 8 (6.00 \pm 1.13)	4 – 8 (5.7 \pm 1.42)

Table 4. Morphometric data of fundatrices, oviparous females and winged males from the type series (see Tab. 1.) of *A. holoenotherae* sp. n. from Lithuania (extreme values and mean \pm d. in parentheses). Characters of discriminative value are in bold. Character abbreviations the same as used in Table 2. All lengths in mm.

Characters	Fundatrices (n = 4)	Oviparae (n = 9)	Males (n = 4)
body	1596-1813 (1684 100)	962-1370 (1211 \pm 125)	1095-1334 (1244 \pm 104)
anten	547-614 (581 32)	378-454 (415 \pm 30)	787-893 (841 \pm 56)
htib	581-607 (593 12)	354-438 (398 \pm 30)	171-222 (193 \pm 22)
ant3	177-196 (186 8)	87-126 (107 \pm 15)	137-151 (144 \pm 6)
ant4	80-90 (84 4)	46-70 (60 \pm 8)	118-152 (131 \pm 15)
*base5	78-90 (84 6)	54-77 (6 \pm 37)	67-84 (7 \pm 78)
*prt5	111-135 (126 11)	91-118 (104+12)	185-205 (193+9)
tars2	79-87 (82 4)	58-71 (66 \pm 4)	69-91 (77 \pm 10)
siphon	179-195 (185 7)	81-103 (92 \pm 9)	69-89 (81 \pm 1)
cauda	154-186 (167 15)	88-127 (115 \pm 13)	79-99 (85 \pm 1)
urs	127-133 (129 3)	106-118 (111 \pm 4)	106-127 (117 \pm 11)
lhant3	14-19 (18 2)	12-18 (14 \pm 2)	18-24 (21 \pm 2)
awant3	17-20 (19 1)	15-19 (17 \pm 2)	18-22 (20 \pm 2)
hant3	5-6 (5.50 0.58)	2-5 (3.22 \pm 0.98)	5-8 (6.50 \pm 1.29)
hurs	6-8 (7.25 0.96)	5-6 (5.75 \pm 0.46)	6-7 (6.50 \pm 0.58)
rhant3	0	0	21-33 (25.2 \pm 55.44)
rhant4	0	0	16-25 (20.25 \pm 4.43)
rhant5	0	0	6-14 (10.50 \pm 3.42)
rhant6	0	0	0-2 (1.00 \pm 0.82)
hcauda	8-11 (9.25 1.26)	7-9 (8.11 \pm 0.93)	6-8 (7.00 \pm 1.15)
mt2-6	0	0	0
mt1,7	4	4	4
scplhtibi	0	57-91 (76.11 \pm 9.73)	0

* for males, it was base6 and prt6, respectively, because their antennae have six antennal segments

Table 5. Morphometric data of alate viviparous females of *Aphis oenotherae* (samples from Manitoba, California and North Carolina) and the type series (see Tab. 1.) of *A. holoenotherae* sp. n. from Lithuania (extreme values and mean s. d. in parentheses). Similar data of *A. grossulariae* from *Epilobium adenocaulon* (after RAKAUSKAS, 1998) and *A. oenotherae* (after PALMER, 1952) are given for comparison. Characters of discriminative value are in bold. Character abbreviations the same as used in Table 2. All lengths in mm.

Characters	<i>A. holoenotherae</i> (n = 18)	<i>A. oenotherae</i> , our data (n = 14)	<i>A. oenotherae</i> (Palmer 1952: 158)	<i>A. grossulariae</i> (n = 20)
body	1414-1784 (1598 ± 106)	1576-2103 (1847 ± 169)		1329-2225 (1696 ± 266)
antennae	720-921 (845+53)	940-1116 (1033+50)		950-1337 (1132+126)
ant3	167-239 (214 ± 18)	211-259 (241 ± 15)	200-340	193-323 (251 ± 36)
ant4	108-162 (130 ± 15)	137-182 (161 ± 13)	140-240	117-233 (168 ± 35)
ant5	88-135 (118 ± 12)	127-159 (143 ± 10)	130-190	107-200 (154 ± 23)
base6	71-102 (86 ± 8)	95-118 (107 ± 8)	100-190	93-137 (115 ± 12)
prt6	146-213 (189+17)	235-288 (256+18)	240-350	273-370 (314+23)
tars2	79-95 (87 ± 4)	91-103 (97 ± 3)		87-103 (94 ± 5)
siphon	124-231 (181 ± 27)	199-263 (231 ± 21)	200-270	183-310 (236 ± 36)
cauda	125-163 (143 ± 10)	133-186 (158 ± 17)	110-140	140-190 (170 ± 12)
urs	124-149 (138 ± 8)	137-159 (147 ± 6)		123-153 (137 ± 8)
lhant3	20-30 (24 ± 3)	22-30 (26 ± 2)	40	25-37 (30+4)
awant3	17-23 (20 ± 1)	20-24 (22 ± 1)		18-25 (21 ± 2)
hant3	3-8 (5.33 ± 1.24)	4-10 (7.57 ± 1.50)		5-12 (7.85 ± 2.23)
hurs	6-9 (7.11 ± 1.08)	6-11 (8.14 ± 1.17)		6-9 (7.25 ± 1.22)
rhant3	8-15 (11.11 ± 1.94)	12-15 (13.21 ± 0.97)	11-22	8-14 (10.80 ± 1.77)
rhant4	3-7 (4.72 ± 1.13)	3-9 (5.50 ± 1.45)	3-16	2-12 (5.20 ± 2.21)
rhant5	0-2 (0.33 ± 0.59)	0-4 (1.07 ± 1.38)	1-10	0-4 (1.20 ± 1.15)
rhant6	0	0		0
hcauda	6-11 (7.89 ± 1.49)	8-15 (11.79 ± 2.22)	12	8-15 (10.50 ± 2.09)
mt2-6	0	0-1 (0.07 ± 0.27)		0-8 (3.80 ± 2.42)
mt1,7	4-5 (4.11 ± 0.32)	3-4 (3.93 ± 0.27)		3-4 (3.95 ± 0.22)

***Aphis holoenotherae* sp. n. bliźniaczy gatunek nearktycznego *A. oenotherae* Oestlund (Hemiptera: Aphididae)**

Streszczenie

Dwa bliźniacze gatunki rodzaju *Aphis* zasiedlają wiesiołki (*Oenothera* spp.), w Europie: *A. oenotherae* Oestlund i *A. holoenotherae* sp. n. Różnią się one wyraźnie pod względem specjalizacji pokarmowej, cyklów rocznych oraz sekwencji mitochondrialnego genu COI i jądrowego genu EFa1, jednak są one bardzo bliskie morfologicznie. Za najlepszą cechę morfologiczną odróżniającą obydwie gatunki uznano długość wyrostka końcowego ostatniego członu czułków. W pracy opisano nowy gatunek oraz klucze do oznaczania poszczególnych morf. mszyc rodzaju *Aphis* zasiedlających wiesiołki w Europie.

Acknowledgements

The present study has been supported by the Lithuanian State Science and Studies Foundation grant No C 03056.

The Czech Academy of Sciences in co-operation with the Czech Academy of Sciences/Lithuanian Academy of Sciences exchange program.

The Royal Society in co-operation with The Royal Society/Lithuanian Academy of Sciences exchange program.

Our sincere thanks go to R. L. Blackman, P. Brown and J. Martin for their hospitality during my visits to the Natural History Museum in London.

J. Holman and J. Havelka were my cheerful hosts at the Institute of Entomology in České Budejovice.

Kind assistance of W. Wojciechowski, P. Węgierek, A. Czylok (Katowice, Poland), E. Cichocka, W. Goszczyński (Warszawa, Poland), V. Zhuravlev (Kijew, Ukraine), G. Coccuza (Catania, Sicily), P. Stary (Česke Budejovice, Czech Republic) during field sampling in respective countries can not be overestimated.

K. Rostański (Katowice, Poland) has kindly helped with the identification of host plants, also supported aphid material from Italy and Poland.

S. Buga (Belarusian State University, Minsk, Belarus) has kindly supported aphid material from Belarus, S. Barbagalo (University of Catania, Italy) from Sicily, J. Nieto Nafria and N. Perez (Leon University, Spain) from Northern Spain, A. S. Jensen (Moses Lake, WA, USA) from USA, S. H. Lee (Suwon, Rep. of Korea) – from South Korea.

Thanks are due to Jekaterina Bašilova and Nijolė Jasenovičienė (Vilnius University) for the preparation of aphid microscope slides.

