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Taxonomical implications of the comparative study of the genus *Drepanosiphum* Koch, 1855
(Hemiptera: Aphididae, Drepanosiphinae).

Running title: Revision of the genus *Drepanosiphum*

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Abstract. The aim of the study was to review the sexual generation of the species of the aphid
genus *Drepanosiphum* Koch. Oviparous females and males of *D. iranicum* Hille Ris Lambers
are described and illustrated in detail. The poorly known sexuales of *D. acerinum* (Walker),
D. aceris Koch, *D. braggii* Gillette, *D. dixonii* HRL, *D. oregonensis* Granovsky and *D.*
platanoidis (Schrank) are re-described and illustrated in detail. Biometric data for the
oviparous females and males are reported and keys for the sexual generation of the species
that were studied are provided for the first time. The status of the closely related species *D.*
acerinum and *D. caucasicum* as well as *D. platanoidis* and *D. iranicum* is discussed. The
newly recognised species *D. latifemorum* sp. n., which is closely related to *D. oregonensis*, is
described. Blackman and Eastop's general key to the species that are associated with *Acer*
spp. is modified to include the new species. The most significant diagnostic characters of
winged viviparous females of all of the known *Drepanosiphum* species are also provided and
illustrated.

Keywords: aphids, maple, new species, revision, sexuales

1. Introduction

More than 5000 species of aphids (Hemiptera, Aphididae) (Favret, 2015) have been described to date. They are all characterised by apomictic parthenogenesis (clonal or asexual reproduction) as the primary or exclusive mode of reproduction, have been described to date. Despite being fairly rare in animals, aphids are among the organisms that exploit this method of reproduction to the greatest extent, i.e. this adaptation leads to higher population growth in a very short time and allows rapid niche exploitation in a changed habitat (Dixon, 1998). Therefore, the reproductive mode of aphids one of the key component of the damage caused by these economically important pests. Asexual viviparous reproduction ensures a high increase in population during the growing season because natural selection gives the fittest genotypes a considerable demographic advantage due to their sustained clonality. Oviparous sexual reproduction, on the other hand, leads to the production of genetically recombined individuals, i.e. cold-resistant forms of the eggs, thus allowing aphid populations to resist harsh winters and to produce an array of new genotypic combinations each year (Simon et al., 2010). The parthenogenesis (viviparous females) is switched in sexual reproduction (sexuales – oviparous females and males) in almost all aphids. However, as sexual generation occurs for only a short period of time (usually in the autumn), sexuales – the key morphs in the life cycle of aphids are either unknown or have only been briefly described.

One example is the Holarctic genus *Drepanosiphum* Koch, 1855 (Drepanosiphinae), which comprises eight holocyclic species (*D. acerinum* (Walker, 1848), *D. aceris* Koch, 1855, *D. braggii* Gillette, 1907, *D. caucasicum* Dzhibladze, 1962, *D. dixonii* Hille Ris Lambers, 1971, *D. iranicum* Hille Ris Lambers, 1971, *D. oregonensis* Granovsky, 1939, *D. platanoidis* (Schrank, 1801)), which are trophically associated with plants from the genus *Acer* spp. (maples) (Holman, 2009). The unique character of this genus is the presence of winged morphs in parthenogenetic generation exclusively. The key morphological features of

Drepanosiphum include long antennae with a very long processus terminalis, ciliated rhinaria, forelegs with enlarged femora, long cylindrical siphunculi and knobbed cauda. Although the viviparous generations are generally well known (Hille Ris Lambers, 1971; Stroyan, 1977; Heie, 1982; Nieto Nafría and Mier Durante, 1998), sexual morphs have never been properly described or have remained unknown (*D. iranicum*, *D. caucasicum*). As little is known about this generation of the genus, (1) we present a review of the sexual generation of *Drepanosiphum* species with the original keys to identifying oviparous females and males first. Furthermore, because the parthenogenetic generation consists solely of winged females that have a similar morphology, representatives from this genus are considered to be difficult to determine and the status of some species is questionable. In particular, Blackman and Eastop (1994) treated *D. caucasicum* and *D. iranicum* as good species based on the morphological characters and the different host relationship. In contrast, according to Remaudière and Remaudière (1997), *D. caucasicum* is a synonym of *D. acerinum* whereas *D. iranicum*, which was originally described as a subspecies of *D. platanoidis*, is its synonym. (2) Therefore, the second aim of this paper is the discussion of the status of mentioned taxa, which is based on a reinvestigation of the type material of *D. caucasicum* and *D. iranicum*. We also present and illustrate the main diagnostic characters of the winged viviparous females of all of the known species of the genus. (3) Finally, based on the comparative study of winged viviparous females of the genus *Drepanosiphum*, a new species *D. latifemorum* sp. n., which was collected in Morocco, is described and illustrated in detail and an identification key to all of the species that belong to this genus is provided.

This paper is the third (after revision of the genera *Shenahweum* Hottes & Frison (Wieczorek et al. 2013) and *Drepanosiphoniella* Davatchi, Hille Ris Lambers & Remaudière (Wieczorek et al. 2015)) dedicated to the revisionary work of the subfamily Drepanosiphinae, with particular emphasis of the sexual generation.

2. Material and methods

2.1. Taxon sampling

We examined 104 mounted specimens of viviparous females and 67 mounted specimens of the known sexuales of the genus *Drepanosiphum*.

Type material. Paratypes. *D. acerinum* England, Southgate, 7. VIII.1847, four alate viviparous females, sycamore, BMNH 30-31; *D. caucasicum* Avadkhara (Abchazja), 13.VIII.1961, one alate viviparous female, *Acer trautvetteri*, Dzhibl., ZMAS 5225; *D. iranicum* Iran, Karaj, 19.V.1960, four alate viviparous females, *Acer*, v.d. Bosch, BMNH 19771-502, 1984-340; *D. oregonensis* USA, Oregon, Corvallis, one alate viviparous female, *A. macrophyllum*, 3.XI.1914, Granovsky, USNM 503.

Other material studied. Viviparous females: 17 from MNHN, 12 from BMNH, 3 from DEIC, 4 from MZLU, 8 from UŚ, 19 from ZMPA, 21 from ZMUC; sexuales: 28 from MNHN, 15 from BMNH, 2 from MZLU, 4 from UŚ, 8 from ZMPA, 10 from ZMUC.

The material that was studied is deposited in the following scientific collections (preceded by the acronyms that are used in this paper): Natural History Museum, London, UK (BMNH); Muséum national d'Histoire naturelle, Paris, France (MNHN); Deutsche Entomologische Institut, Eberswalde, Germany (DEIC); Lund University, Lund Museum of Zoology, Lund, Sweden (MZLU); U.S. National Museum of Natural History Aphid collection, located at the Henry A. Wallace Beltsville Agricultural Research Center, Beltsville, Maryland, USA (USNM); Department of Zoology, University of Silesia, Katowice, Poland (UŚ); Zoological Institute, Russian Academy of Sciences, St Petersburg, Russia (ZMAS); Zoological Institute, Polish Academy of Sciences, Warsaw, Poland (ZMPA); Zoological Museum, University of Copenhagen, Copenhagen, Denmark (ZMUC).

The holotype and some paratypes of the new species are deposited in the MNHN (Paris, France); one paratype MNHN (EH) 22501 will also be deposited in the aphid collection of the Department of Zoology, University of Silesia, Katowice, Poland (UŚ).

2.2. Methods

One to ten specimens of both oviparous females and males of each species as well as eight specimens of the new species were measured. For the comparative study of the viviparous generation at least ten specimens of each species were studied. The slides were examined using a Nikon Ni-U light microscope and photographed with a Nikon DS-Fi2 camera. Field photographs were taken with a Sony SLT a37 digital camera using Sigma 50 mm macro lenses with external rings. Drawings were made with a camera lucida. A magnified view is provided for each photograph and drawing. Measurements are given in mm (Tables 1-3). Whole specimens (four individuals – two males of *D. iranicum* from the MNHN and two males of *D. platanoidis* from the UŚ aphids collections) for preparing samples for SEM were preserved in 70% ethanol. SEM photographs were taken with a Philips XL 30 ESEM/TMP; the specimens were examined using SE and BSE detectors (Scanning Microscopy Laboratory, Faculty for Earth Sciences, University of Silesia, Poland) in low vacuum conditions, $p = 0.3$ torr.

The following abbreviations (in the descriptions and tables) are used (partly after Blackman and Eastop, 1994): BL—body length (from the anterior border of the head to the end of the cauda); BW—greatest body width across the middle of the abdomen; HW— the greatest head width across the compound eyes or triommatidia; ANT—antennae or their lengths; ANT I-VI—antennal segments I-VI or their lengths (ratios between the antennal segments are simply given as, e.g., ‘VI:III’); BASE—the basal part of the last antennal segment or its length; PT—the processus terminalis of the last antennal segment or its length; ARS— the apical segment

of the rostrum or its length; FEMORA IL—fore femora length; FEMORA IW—fore femora width; FEMORA IIL—middle femora length; FEMORA IIW—middle femora width; TIBIA III—hind tibiae or its length; HT II—the second segment of the hind tarsus or its length; fore wings L—length of fore wings; fore wings W—width of fore wings.

Figures 1-16 present species of sexual generation in alphabetical order, figures 17-21 show characters of viviparous generation of the genus *Drepanosiphum* based on morphological similarities among species studied.

The general key to the species associated with *Acer* spp. by Blackman and Eastop (2015) have been modified to include *D. latifemorum* sp. n. as follows, respecting terminology, abbreviations and expressions. The terminology of the male genitalia follows Wieczorek et al. (2011).

3. Systematics

Genus *Drepanosiphum* Koch, 1855

Type species: *Aphis platanoidis* Schrank, 1801; by subsequent designation (Mordvilko, 1909: 379)

Depranosiphum Kaltenbach, 1874
Drepanosiphon Del Guercio, 1914
Drepanosiphon Börner, 1931
Drepanosyphum Macchiati, 1883
Platanaphis Amyot, 1847

3.1. The sexual generation

3.1.1 Shared characters of the sexuales of the genus *Drepanosiphum*.

Oviparous females. The body is oval with the end of the abdomen elongated. The head has compound eyes with triommatidia. The frons is concave for half of the width and has a well-developed epicranial suture. The 6-segmented antennae are covered with short, almost colorless setae that are never longer than the basal articular diameters of ANT III. ANT I is

1 large and almost rectangular with a slightly narrower basal part and has a small protuberance
2 in the middle part of the inner side of the segment. ANT II is square shaped. ANT III is
3 slightly wider at the base than at the end but also has a slightly wider apex. ANT V has one
4 rounded and ciliated primary rhinarium at the apex. The BASE has one rounded and ciliated
5 major rhinarium and a variable number of accessory rhinaria; the proximal and distal ones are
6 almost as large as the major rhinarium. Other accessory rhinaria are situated in the area of
7 major rhinarium. The ARS has a slightly blunt apical part. The dorsal side of the thorax
8 (except for *D. braggii*) has a polygonal reticulation. The hind tibiae have transverse rows of
9 fine, short spinules on 1/2 of their length. The empodial setae are spatulate. The abdominal
10 tergites have setae that are in spinal, pleural and marginal positions. The siphunculi are
11 tubular and are wider at the base and narrow slightly towards the apex and have a well-
12 developed flange. The subgenital plate is almost invisible, and is only noticeable due to its
13 very poor sclerotisation and chaetotaxy. The cauda is knobbed and is slightly constricted near
14 the base and has long, fine and pointed setae.

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34 **Males.** The males are winged and have an elongate body. The head has large compound eyes
35 with triommatidia and three ocelli. The frons is flat with well-developed, smooth and
36 diverging antennal tubercles. The 6-segmented antennae have numerous very short, almost
37 transparent setae and numerous ciliated oval or rounded secondary rhinaria on ANT III-V.
38 ANT I is almost rectangular and has a small protuberance in the middle part of the inner side
39 of the segment. ANT II is square shaped. ANT III is wider at the base and slightly narrower at
40 the apex. ANT V has one large and ciliated primary rhinarium at the apex. The BASE has one
41 major, ciliated rhinarium and a variable number of accessory rhinaria; the proximal and distal
42 ones almost as large as or slightly smaller than the primary rhinarium. Other accessory
43 rhinaria are situated in the area of the major rhinarium. The PT has two basal and four apical
44 setae (with the exception of *D. oregonensis*). The rostrum reaches the mesosternum. The ARS

has a slightly blunt apical part. The fore femora are enlarged. The tibiae have transverse rows of short spinules and long, erect, pointed setae on the distal part. The empodial setae are spatulate. The fore wings are typical and have a normal venation; the radius is strongly curved the media have three branches. The hind wings have two oblique veins. The abdomen has a variable number of spinal and spino-pleural cross-bars that have different shapes. The abdominal tergites have fine and pointed setae in the spinal, pleural and marginal positions. The siphunculi are tubular and are slightly wider at the base and have a well-developed flange and a conspicuous dark brown or black spot in the front of the base of each siphunculus (except for *D. braggii*). The surface of the siphunculi is wrinkled. The cauda is knobbed and has fine and pointed setae. The parameres and the basal part of the phallus are covered with numerous short setae. The distal part of the sclerotised arms is rather long and thin whereas the proximal part is shorter and wider. The exception is *D. dixonii* in which both the distal and proximal sections of the sclerotised arms are robust.

3.1.2. Key to species of *Drepanosiphum* based on wingless oviparous females (oviparous females of *D. caucasicum* and *D. latifemorum* sp. n. unknown)

1. Dorsum membranous. Dorsal side of thorax without reticulation. Abdominal tergites with only pale, small and inconspicuous scleroites. PT:BASE 9.16-11.61; ANT VI:ANT III 1.52-1.77..... *D. braggi* Gillette
- Dorsum more or less sclerotised. Dorsal side of thorax with reticulation. Abdominal tergites with at least 1-2 pleural sclerites and well-visible pale brown scleroites, but commonly with dark cross bars. PT:BASE < 9.16; ANT VI:ANT III < 1.45..... **2**
2. Abdominal tergites I-VI with pointed setae (some can have only slightly blunt apices) arising from separate sclerites (or 1-2 spinal sclerites) *D. oregonensis* Granovsky

- Abdominal tergites I-VI with variously shaped setae arising from at least spino-pleural sclerites or dorsum with cross bars **3**
- 3.** Knee area of legs uniformly light pigmented. ANT VI:ANT III 1.19-1.26. Pseudosensoria on hind tibiae > 143 *D. acerinum* (Walker)
- Knee area of legs distinctly dark pigmented. ANT VI:ANT III < 1.06. Pseudosensoria on hind tibiae < 136 **4**
- 4.** Abdominal tergites I-VI have forked or spatulate setae..... **5**
- Abdominal tergites I-VI have forked, capitate or club-shaped setae..... **6**
- 5.** Abdominal tergites I-VI have forked setae. Siphunculi pale or light brown with dusky apices. Cross bars with transverse rows of small spinules *D. aceris* Koch
- Abdominal tergites I-VI have spatulate setae. Siphunculi uniformly light brown. Cross bars without transverse rows of small spinules *D. dixonii* Hille Ris Lambers
- 6.** Abdominal tergites I-VI have forked and club-shaped setae. ANT III- ANT VI yellow or pale with only apices dusky..... *D. iranikum* Hille Ris Lambers
- Abdominal tergites I-VI have forked and capitate setae. ANT III-VI uniformly dark pigmented with only basal area of ANT III yellow *D. platanoidis* (Schränk)

3.1.3. Key to species of *Drepanosiphum* based on winged males (males of *D. caucasicum* and *D. latifemorum* sp. n. unknown)

- 1.** The sclerotisation of the body is pale to yellow. Spino-pleural bars only on abdominal tergites IV-V (on abdominal tergite III only spinal plate). ANT VI:ANT III 1.42-1.54; ANT V:ANT III 0.83-0.90 *D. braggi* Gillette
- The sclerotisation of the body is brown to dark pigmented. Spino-pleural bars not only on abdominal tergites IV-V; ANT VI:ANT III < 1.42; ANT V:ANT III < 0.80.....**2**

2. HW:ANT 0.11 and less; PT 1.20 mm long and more..... **3**
- HW:ANT 0.12 and more; PT 1.12 mm and less **4**
3. Cross bar on abdominal tergite V as large as cross bar on abdominal tergite IV. Siphunculi light pigmented. Pterostigma pale or uniformly pigmented. Distal ends of fore wings distinctly dusky *D. aceris* Koch
- Cross bar on abdominal tergite V larger and wider than cross bar on abdominal tergite IV. Siphunculi dark pigmented. Pterostigma pale with dark spot distally. Distal ends of fore wings pale *D. dixonii* Hille Ris Lambers
4. The legs only have darker knee areas. Ends of tibiae yellow or pale. ANT III has less than 90 rhinaria; ARS:HT II < 0.66 **5**
- The legs have dark knee areas and clearly dark ends of the tibiae. ANT III has more than 90 rhinaria. ARS:HT II > 0.73 **6**
5. Large spino-pleural bars are present on abdominal tergites I-VIII. ANT V has 27-28 rhinaria. Pterostigma pale with dark pigmented edge..... *D. oregonensis* Granovsky
- Large spino-pleural bars only on abdominal tergites III-V (abdominal tergite VI has a spinal sclerite). ANT V has 8-17 rhinaria. Pterostigma uniformly pigmented..... *D. acerinum* (Walker)
6. ANT V has 9-32 rhinaria. The entire area of the fore wings is covered with minute scales..... *D. platanoidis* (Schrank)
- ANT V has 5-8 rhinaria. Area between media and cubitus only at the edge of the wing with minute scales, large ones only and the tips of branches of the veins *D. iranicum* Hille Ris Lambers.

3.1.4. Species descriptions

Drepanosiphum acerinum (Walker, 1848)

Drepanosiphum gracilis Börner, 1940

(Figs 1–2; Tables 1–2).

Redescription. Oviparous female (Fig. 1a; Table 1) (n=4). **Pigmentation.** Colour of live specimens: buff or yellowish with apices of antennae, siphunculi, knee area, tarsi and abdominal sclerites dark brown (Walker, 1848); mounted specimens: body in general light yellow. Antennal segments pale with slightly darker apices and BASE. Legs yellow with dusky distal part of tibiae. Abdominal sclerotisation light brown. Siphunculi pale with dusky apices. **Morphometric characters.** ANT 1.14-1.17 x BL and 0.16-0.17 x HW. ANT IV slightly shorter or as long as ANT V. ANT V always shorter than ANT VI. PT 6.50-7.11 x BASE; other antennal ratios: VI:III 1.19-1.26, V:III 0.79-0.86, IV:III 0.75-0.87. ANT I with 10-11 setae, ANT II with 3 setae, ANT III with 42-50 setae (Fig. 1b), ANT IV with 19-30 setae, ANT V with 15-16 setae. PT with 2 basal and 4 apical setae. Antennal setae fine and slightly blunt. BASE with 6-10 accessory rhinaria. Rostrum reaching middle coxae. ARS with 6-8 accessory setae, 0.10-0.13 x ANT III and 0.62-0.73 x HT II. Hind tibiae slightly swollen in proximal part with 3-4 rastral spines and 143-165 oval, circular or irregular pseudosensoria on almost whole length of tibiae (Fig. 1c). Abdominal tergites I-VI with partly fused spino-pleural sclerites; tergites II-V with marginal sclerites; tergites VII-VIII without sclerites. Abdominal tergites I-VI with pale, blunt (Fig. 1d) or slightly forked (Fig. 1e) 0.075-0.105 mm long setae; tergites VII-VIII with fine and pointed (Fig. 1f) 0.115-0.135 mm long setae. Surface of siphunculi smooth (Fig. 1g). Cauda with 13-15 setae.

Redescription. Male (Table 2) (n=3). **Pigmentation.** Colour of live specimens: bright yellowish-green with abdominal sclerites dark brown (Walker, 1848); mounted specimens: ANT I-II, head (Fig. 2a) brown. ANT III-VI, BASE light brown with paler basal part of ANT III and PT. Meso and metathorax brown. Veins of fore wings light brown, pterostigma light

1 brown (Fig. 2b). Femora pale yellow, tibiae pale yellow with darker knee areas. Tarsi light
2 brown. Siphunculi and abdominal sclerotisation brown. Genitalia and cauda pale.
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4 **Morphometric characters.** ANT 1.57-1.94 x BL and 0.12-0.13 x HW. ANT III with 68-84
5 rhinaria (Fig. 2c). ANT IV slightly shorter than ANT V, with 25-27 rhinaria. ANT V with 8-
6 17 rhinaria. ANT VI longer than other segments, BASE with 4-9 accessory rhinaria. PT 8.0 x
7 BASE; other antennal ratios: VI:III 1.17-1.23, V:III 0.66-0.75, IV:III 0.68-0.81. ANT I with
8 13-15 setae, ANT II with 3-4 setae, ANT III with 40-41 setae, ANT IV with 14-16 setae,
9 ANT V with 12-14 setae. ARS with 6 accessory setae, 0.07-0.09 x ANT III and 0.64-0.71 x
10 HT II. Hind tibiae with 3-4 rastral spines. Abdominal tergites III-V with spino-pleural
11 sclerites; tergite VI with spinal sclerite; tergites III-IV with pale marginal sclerites, tergites II
12 and VII with small spinal sclerites at setae bases (Fig. 2d). Abdominal tergites with 0.075-
13 0.100 mm long setae. Cauda with 8-10 setae. Genitalia with small, lobate parameres and
14 elongated, smooth, hooked-shaped basal part of phallus (Fig. 15a).
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34 *Drepanosiphum aceris* Koch, 1855

35 (Figs 3–4; Tables 1–2).

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38 **Redescription. Oviparous female** (Fig. 3a; Table 1) (n=8). **Pigmentation.** Colour of live
39 specimens: light green with dark brown abdominal sclerotisation; mounted specimens: body
40 in general pale. Antennal segments III-V yellow with darker apices and basal part, BASE
41 light brown, PT yellow. Legs yellow with knee area and distal part of hind tibiae dark brown.
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43 Siphunculi pale or light brown with darker apices. Abdominal sclerotisation light brown
44 (some specimens much paler, without distinct and pigmented abdominal sclerotisation).
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53 **Morphometric characters.** ANT 1.07-1.42 x BL and 0.14-0.19 x HW. ANT III longest (Fig.
54 3b). ANT IV slightly longer than ANT V. ANT V always shorter than ANT VI. PT x 6.25-
55 6.80 BASE; other antennal ratios: VI:III 0.85-0.97, V:III 0.60-0.67, IV:III 0.70-0.72. ANT I
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with 8-9 setae, ANT II with 3-4 setae, ANT III with 40-42 setae, ANT IV with 19-23 setae, ANT V with 12-16 setae. PT with 2 basal and 4 apical setae. Antennal setae fine and pointed. BASE with 2-3 accessory rhinaria. Rostrum reaching middle coxae. ARS with 8 accessory setae, $0.14 \times$ ANT III and $0.75-0.77 \times$ HT II. Hind tibiae not swollen, with 3 rastral spines and 95-100 small circular pseudosensoria located from distal part to about half of length of tibiae (Fig. 3c). Abdominal tergites I-V with spino-pleural bars and black spot in front of base of each siphunculus; tergites VI-VIII without sclerites. Abdominal tergites with yellow or light brown forked (Fig. 3d) 0.10-0.15 mm long setae arranged in transverse rows; tergites VII-VIII with pointed (Fig. 3e) 0.115-0.135 mm long setae. Siphunculi wrinkled (Fig. 3f). Cauda with 10-12 setae.

Redescription. Male (Table 2) (n=3). **Pigmentation.** Colour of live specimens: light green with dark brown abdominal sclerotisation, legs and antennae dusky; mounted specimens: head (Fig. 4a) and thorax yellowish. Antennae uniformly yellow. Veins of fore wings yellow, pterostigma and distal tip of fore wings (between ends of Rs and M) dusky (Fig. 4b). Femora and tibiae yellow with darker knee areas and distal parts of tibiae. Tarsi light brown. Siphunculi yellow to light brown. Genitalia light brown, cauda pale. **Morphometric characters.** ANT $1.80-2.07 \times$ BL and $0.10-0.12 \times$ HW. ANT III with 132-150 rhinaria (Fig. 4c). ANT IV slightly longer than ANT V with 62-71 rhinaria. ANT V with 23-25 rhinaria. BASE with 4 accessory rhinaria. PT $8.27-10.85 \times$ BASE; other antennal ratios: VI:III 1.06-1.25, V:III 0.77-0.79, IV:III 0.82-0.87. ANT I with 10-11 setae, ANT II with 4 setae, ANT III with 37-41 setae, ANT IV with 16-19 setae, ANT V with 10-15 setae. ARS with 8 accessory setae, $0.11 \times$ ANT III and $1.00 \times$ HT II. Hind tibiae with 5 rastral spines. Abdominal tergites III-V with spino-pleural bars; tergites I-II with small spinal sclerites (Fig. 4d). Abdominal tergites with 0.13-0.16 mm long setae. Cauda with 5-6 setae. Genitalia with large lobate parameres and short hooked-shaped basal part of phallus (Fig. 15b).

***Drepanosiphum braggii* Gillette, 1907**

(Figs 5–6; Tables 1–2).

Redescription. Oviparous female (Fig. 5a; Table 1) (n=7). **Pigmentation.** Colour of live specimens: varying from very light greenish-yellow to dusky yellow (Gillette, 1907); mounted specimens: body in general pale. ANT I–V pale with darker apices of ANT III–V, BASE dark brown, PT light brown. Legs yellowish (some specimens with darker knee areas). Siphunculi pale with dark apices or light brown with darker apices. **Morphometric characters.** ANT 1.48–1.94 x BL and 0.12–0.13 x HW. ANT IV slightly shorter or as long as ANT V. ANT V always shorter than ANT VI. PT 9.16–11.61 x BASE; other antennal ratios: VI:III 1.52–1.77, V:III 0.87–1.00, IV:III 0.77–1.06. ANT I with 10–11 setae, ANT II with 3–4 setae, ANT III with 39–70 setae, ANT IV with 21–40 setae, ANT V with 16–21 setae. PT with 1–2 basal and 4 apical setae. Antennal setae short, slightly blunt. ANT III with 0–3 secondary rhinaria (Fig. 5b). BASE with 5–6 accessory rhinaria. Rostrum reaching behind middle coxae. ARS with 8–12 accessory setae, 0.11–0.16 x ANT III and 0.82–1.05 x HT II. Hind tibiae not swollen, with 5–6 rastral spines and 42–76 oval or circular pseudosensoria, located from proximal part to about half of length of tibiae (Fig. 5c). Abdominal tergites I–VIII only with small, pale and inconspicuous scleroites at the bases of setae. Abdominal tergites I–VI with 0.10–0.17 mm long pale, forked (Fig. 5d) setae arranged in transverse rows; tergites VII–VIII with 0.17–0.18 mm long slightly blunt (Fig. 5e) setae. Surface of siphunculi slightly wrinkled (Fig. 5f). Cauda with 7–8 setae.

Redescription. Male (Table 2) (n=2). **Pigmentation.** Colour of live specimens: very light green or greenish-yellow with brown head, thorax and siphunculi (Gillette, 1907); mounted specimens: head (Fig. 6a) and thorax yellowish to light brown. ANT III–V yellow or light brown with darker apices. BASE brownish with PT pale. Veins of fore wings yellow, pterostigma pale with brown strip on the basal part (Fig. 6b). Femora pale or yellow, tibiae

light brown with lighter distal parts of tibiae. Tarsi light brown. Siphunculi yellow with darker apices. Genitalia light brown, cauda pale. **Morphometric characters.** ANT 1.75-1.89 x BL and 0.12-0.13 x HW. ANT III with 97-103 rhinaria (Fig. 6c). ANT IV almost as long as ANT V with 42-50 rhinaria. ANT V with 25-28 rhinaria. BASE with 3-5 accessory rhinaria. PT 10.00-10.33 x BASE; other antennal ratios: VI:III 1.42-1.54, V:III 0.83-0.90, IV:III 0.80-0.86. ANT I with 9 setae, ANT II with 3 setae, ANT III with 55-60 setae, ANT IV with 21-26 setae, ANT V with 21-22 setae. ARS with 8-10 accessory setae, 0.12-0.13 x ANT III and 0.84-0.87 x HT II. Hind tibiae with 5 rastral spines. Abdominal tergite III with spinal sclerites, tergites IV-V with spino-pleural bars (some specimens with small spinal sclerite on tergite VI), tergite IV-V with marginal sclerites (Fig. 6d). Abdominal tergites with 0.050-0.053 mm long setae. Cauda with 7-8 setae. Genitalia with large lobate parameres and short square-shaped basal part of phallus (Fig. 15c).

Drepanosiphum dixonii Hille Ris Lambers, 1971

(Figs 7–8; Tables 1–2).

Redescription. Oviparous female (Fig. 7a; Table 1) (n=1). **Pigmentation.** Colour of live specimens: unknown; mounted specimens: body in general yellowish. ANT I-II, head and thorax light brown. ANT III-VI yellowish with darker apices of ANT III-V. Legs yellow with dark knee areas. Siphunculi brown. Abdominal sclerotisation light brown. **Morphometric characters.** ANT 1.49-1.50 x BL and 0.15 x HW. ANT IV slightly longer than ANT V. ANT V shorter than ANT VI. PT 4.84-5.62 x BASE; other antennal ratios: VI:III 0.94-1.06, V:III 0.80-0.85, IV:III 0.91-0.93. ANT I with 10-11 setae, ANT II with 4-5 setae, ANT III with 41-51 setae (Fig. 7b), ANT IV with 25-26 setae, ANT V with 13-15 setae. PT with 2 basal and 4 apical setae. Antennal setae slightly blunt. ANT III with 1 secondary rhinarium. BASE with 5 accessory rhinaria. Rostrum reaching behind middle coxae. ARS with 7-8 accessory setae,

0.13-0.14 x ANT III and 0.93-0.96 x HT II. Hind tibiae slightly swollen at proximal part, with 4 rastral spines and 75-92 circular pseudosensoria, located from the proximal part to about 2/3 of the length of tibiae (Fig. 7c). Abdominal tergites I-V with large, longitudinal, spino-pleural bars and marginal sclerites; tergites VI-VIII not sclerotised, with only pale, small scleroites at bases of setae. Abdominal tergites I-VI with pale brown, spatulate (Fig. 7e) or capitate (Fig. 7f) 0.07-0.08 mm long setae; tergites VII-VIII with colourless, slightly forked (Fig. 7d) 0.10-0.15 mm long setae. Surface of siphunculi wrinkled (Fig. 7g). Cauda with 9-10 setae.

Redescription. Male (Table 2) (n=1). **Pigmentation.** Colour of live specimens: unknown; mounted specimens: ANT I-II, head (Fig. 8a), thorax, abdominal sclerotisation, siphunculi and genitalia dark brown. Antennae light brown; ANT III with darker basal part and apex. Costa, distal end of pterostigma and radius of fore wing dark brown (Fig. 8b). Legs light brown with black knee area. Cauda pale. **Morphometric characters.** ANT 2.00 x BL and 0.11 x HW. ANT III with 81-88 rhinaria (Fig. 8c). ANT IV as long as ANT V or slightly shorter with 31-34 rhinaria. ANT V with 13-17 rhinaria. ANT VI longer than other segments; BASE with 3-4 accessory rhinaria. PT 7.81-8.19 x BASE; other antennal ratios: VI:III 1.05-1.06, V:III 0.77-0.79, IV:III 0.77. ANT I with 10-13 setae, ANT II with 5 setae, ANT III with 43-47 setae, ANT IV with 22 setae, ANT V with 18 setae. ARS with 8 accessory setae, 0.10 x ANT III and 0.96 x HT II. Hind tibiae with 5 rastral spines. Abdominal tergites III-V with spino-pleural bars and marginal sclerites; tergites I-II and VI-VIII with small scleroites (Fig. 8d). Abdominal tergites with 0.05-0.09 mm long setae. Cauda with 8 setae. Genitalia well developed, with small lobate parameres and elongated, almost rectangular basal part of phallus (Fig. 15d).

Drepanosiphum iranicum Hille Ris Lambers, 1971

(Figs 9–10; Tables 1–2).

Description. Oviparous female (Fig. 9a; Table 1) (n=10). **Pigmentation.** Colour of live specimens: unknown; mounted specimens: pale. ANT I-II, head and pronotum light brown. ANT III light brown with slightly darker area of base and black apices. ANT IV with black base and brown apex. ANT V with base and brown apex. BASE brown, PT yellowish. Femora yellowish. Tibiae yellowish with dark knee area. Abdominal sclerotisation brown with black spot near base of each siphunculus. Siphunculi pale with light brown apices.

Morphometric characters. ANT 1.04-1.38 x BL and 0.14-0.17 x HW. ANT IV slightly shorter than ANT V. ANT V almost as long as ANT VI. PT 5.33-6.53 x BASE; other antennal ratios: VI:III 0.63-0.87, V:III 0.56-0.77, IV:III 0.67-0.85. ANT I with 12-16 setae, ANT II with 3-5 setae, ANT III with 40-65 setae, ANT IV with 20-34 setae, ANT V with 14-20 setae. PT with 1-3 basal and 4 apical setae. ANT III with 0-1 secondary rhinarium (Fig. 9b); ANT IV with 0-1 secondary rhinarium; BASE with 3 accessory rhinaria. Rostrum reaching middle coxae. ARS with 8-10 accessory setae, 0.11-0.14 x ANT III and 0.81-1.00 x HT II. Hind tibiae not swollen with 4 rastral spines and 32-90 circular and irregular pseudosensoria located on whole surface of proximal part of tibiae (Fig. 9c). Abdominal tergites I-V with large, longitudinal, fused or partially fused spinal sclerites, small, rounded pleural ones and large, rounded marginal sclerites; tergites VI-VII not sclerotised, with only pale brown small sclerites at base of setae. Abdominal tergites I-VI with pale, slightly forked (Fig. 9d) or club-shaped (Fig. 9e) setae 0.17-0.20 mm long; tergites VII-VIII with pointed (Fig. 9f) 0.18-0.20 mm long setae. Surface of siphunculi wrinkled (Fig. 9g). Cauda with 5-6 setae.

Redescription. Male (Table 2) (n=4). **Pigmentation.** Colour of live specimens: unknown; mounted specimens: head (Fig. 10a) and thorax dark brown. Antennae brown with middle part of ANT V and PT pale. Veins of fore wings brown, pterostigma light brown with darker

edge (Fig. 10b). Femora yellow, tibiae light brown with black knee areas and distal parts brown. Tarsi brown. Abdominal sclerotisation light brown. Siphunculi and genitalia light brown. Cauda pale. **Morphometric characters.** ANT 1.16-1.84 x BL and 0.13-0.15 HW. ANT III with 150-160 rhinaria (Fig. 10c). ANT IV almost as long as ANT V with 50-62 rhinaria. ANT V with 5-8 rhinaria. ANT VI almost as long as ANT IV and V; BASE with 3-4 accessory rhinaria. PT 5.29-6.92 x BASE; other antennal ratios: VI:III 0.61-0.67, V:III 0.60-0.64, IV:III 0.69-0.78. ANT I with 17-20 setae, ANT II with 5 setae, ANT III with 50-57 setae, ANT IV with 50-62 setae, ANT V with 12-15 setae. ARS with 6 accessory setae, 0.09-0.10 x ANT III and 0.83-0.94 x HT II. Tibiae with 3-4 rastral spines. Area between media and cubitus only at the edge of the fore wing with minute scales, larger ones only and the tips of branches of veins (Fig. 10b). Abdominal tergites I-VII with spino-pleural bars, tergites III-V with marginal sclerites (Fig. 10d). Abdominal tergites with 0.09-0.13 mm long setae. Cauda with w 4-5 setae. Genitalia with very large lobate parameres and very short, square-shaped basal part of phallus (Fig. 15e, f).

Drepanosiphum oregonensis Granovsky, 1939

(Figs 11–12; Tables 1–2).

Drepanosiphum steveni Bozhko, 1961

Drepanosiphum zimmermanni Börner, 1940

Redescription. Oviparous female (Fig. 11a; Table 1) (n=2). **Pigmentation.** Colour of live specimens: olive green with head, thorax and abdominal sclerites dark brown to black, siphunculi brown with black apices; mounted specimens: body in general pale. ANT I-II, head, abdominal sclerotisation light brown. ANT III-V pale with light brown apices, ANT VI dark brown. Legs with darker knee areas. Siphunculi pale with slightly darker apices.

Morphometric characters. ANT 1.27 x BL and 0.22 x HW. ANT IV slightly shorter or as long as ANT V. ANT V always shorter than ANT VI. PT 6.46 x BASE; other antennal ratios: VI:III 1.38-1.42, V:III 0.77-0.84, IV:III 0.82-0.85. ANT I with 9-10 setae, ANT II with 3-4

setae, ANT III with 35-37 setae (Fig. 11b), ANT IV with 17-20 setae, ANT V with 13-16 setae. PT with 2 basal and 4 apical setae. Antennal setae fine and pointed. BASE with 2-3 accessory rhinaria. Rostrum reaching middle coxae. ARS with 8 accessory setae, 0.14 x ANT III and 0.62-0.66 x HT II. Hind tibiae not swollen, with 4 rastral spines and 90-105 circular pseudosensoria, located from proximal part to about 3/4 of the length of tibiae (Fig. 11c). Abdominal tergites I-V with partly fused spino-pleural bars and marginal sclerites. Abdominal tergites I-VIII with, fine and pointed (Fig. 11d) 0.125-0.17 mm long setae and a few setae with slightly blunt apices (Fig. 11e). Surface of siphunculi slightly wrinkled (Fig. 11f). Cauda with 12 setae.

Redescription. Male (Table 2) (n=2). **Pigmentation.** Colour of live specimens: greenish with head, thorax and abdominal sclerites dark brown to black, antennae, knee area, siphunculi black; mounted specimens: head (Fig. 12a), antennae, thorax and abdominal sclerites brown. Veins of fore wings light brown; pterostigma pale with dark edge (Fig. 12b). Femora yellowish-light brown with darker knee areas. Siphunculi, genitalia and cauda light brown. **Morphometric characters.** ANT 1.38-1.42 x BL and 0.14-0.16 x HW. ANT III with 75-77 rhinaria (Fig. 12c). ANT IV slightly longer or as long as as ANT V with 32-51 rhinaria. ANT V with 27-28 rhinaria. BASE with 4-5 accessory rhinaria. PT 7.07-7.28 x BASE; other antennal ratios: VI:III 1.10-1.14, V:III 0.68-0.72, IV:III 0.71-0.74. ANT I with 10-11 setae, ANT II with 4 setae, ANT III with 48-52 setae, ANT IV with 21-25 setae, ANT V with 15-20 setae. ANT VI with 2-3 basal and 4 apical setae. ARS with 6-8 accessory setae, 0.10 x ANT III and 0.65-0.66 x HT II. Hind tibiae with 3 rastral spines. Abdominal tergites I-VII with spino-pleural and marginal sclerites (Fig. 12d). Abdominal tergites with 0.09-0.15 mm long setae. Cauda with 4-6 setae. Genitalia with large lobate parameres and elongated, hooked-shaped basal part of phallus (Fig. 15g).

Drepanosiphum platanoidis (Schränk, 1801)

Aphis aceris pseudoplatani Mosley, 1841

Drepanosiphum californicum Mordvilko, 1928

Aphis platanoidis Hartig, 1841

Drepanosiphum smaragdinum Koch, 1855

Drepanosiphum tiliae Koch, 1855

(Figs 13–14; Tables 1–2).

Redescription. Oviparous female (Fig. 13a; Table 1) (n=10). **Pigmentation.** Colour of live specimens: yellowish with light green markings on thorax and abdomen, legs and antennal segments IV–VI dusky; mounted specimens: body yellowish to brown. ANT I–II, head and thorax, legs light brown. ANT III–V light brown with dark brown apices, BASE dark brown, PT pale. Legs light brown with paler middle parts of tibiae. Abdominal sclerotisation brown with black spot near base of each siphunculi. Siphunculi pale with darker apices (Fig. 16b–d).

Morphometric characters. ANT 0.93–1.22 x BL and 0.16–0.21 x HW. ANT IV slightly shorter or as long as ANT V. ANT V always shorter than ANT VI. PT 6.00–6.72 x BASE; other antennal ratios: VI:III 0.71–1.06, V:III 0.59–0.80, IV:III 0.69–0.89. ANT I with 10–11 setae, ANT II with 3–4 setae, ANT III with 39–70 setae and 0–3 secondary rhinaria (Fig. 13b), ANT IV with 21–40 setae, ANT V with 16–21 setae. PT with 1–2 basal and 4 apical setae. Antennal setae fine and slightly blunt. BASE with 2–3 accessory rhinaria. Rostrum reaching middle coxae. ARS with 8–12 accessory setae, 0.11–0.16 x ANT III and 0.70–1.07 x HT II. Hind tibiae not swollen, with 5–6 rastral spines and 48–136 oval or circular pseudosensoria with small indentation from the inner side, located from the distal part to about half of length of tibiae (Fig. 13c). Abdominal tergites I–VI with large spino-pleural bars and marginal sclerites. Abdominal tergites I–VI with pale, capitate (Fig. 13e) or forked (Fig. 13f) 0.10–0.16 mm long setae; tergites VII–VIII with pointed (Fig. 13d) 0.17–0.18 mm long setae. Surface of siphunculi wrinkled (Fig. 13g). Cauda with 7–8 pointed setae.

Redescription. Male (Table 2) (n=10). **Pigmentation.** Colour of live specimens: head, antennae, distal part of tibiae and tarsi, genitalia, thorax and abdominal sclerotisations dark brown, thorax light brown, abdomen dark green; mounted specimens: yellow to light brown. Head (Fig. 14a) and thorax yellowish to brown. Antennae dark brown with darker apices. Veins of fore wings brown; pterostigma pale with brown strip on basal part (Fig. 14b). Legs light brown with darker knee area and apices of tibiae. Siphunculi yellow with darker apices. Genitalia light brown, cauda pale. Abdominal sclerotisation dark brown (Fig. 16a, c-d) (some specimens much paler with not distinct dark coloration). **Morphometric characters.** ANT 1.15-1.69 x BL and 0.12-0.18 x HW. ANT III with 120-180 rhinaria (Fig. 14c). ANT IV almost as long as ANT V with 27-75 rhinaria. ANT V with 9-32 rhinaria. ANT VI longer than other segments, BASE with 3-4 accessory rhinaria. PT 6.00-8.08 x BASE; other antennal ratios: VI:III 0.67-1.09, V:III 0.62-0.80, IV:III 0.69-1.02. ANT I with 9 setae, ANT II with 3 setae, ANT III with 55-60 setae, ANT IV with 21-26 setae, ANT V with 21-22 setae. ARS with 8-10 accessory setae, 0.08-0.15 x ANT III and 0.73-0.88 x HT II. Hind tibiae with 5 rastral spines. Abdominal tergites I-VI with spino-pleural bars; tergite VI with spinal sclerite (Fig. 14d). Abdominal tergites with 0.050-0.053 mm long setae. Cauda with 7-8 setae. Genitalia with large lobate parameres and short, finger-like basal part of phallus (Fig. 15h,i).

3.2. The viviparous generation

3.2.1. Diagnostic characters of the *Drepanosiphum* species - winged viviparous female

The most important diagnostic characters of the winged viviparous females include: the number of rhinaria and the colouration of ANT III (Fig. 17a-i), the number and distribution of the accessory rhinaria of the BASE (Fig. 18a-i), the colouration of the fore wings and the distribution of minute scales (Fig. 19a-i), the colouration of the hind legs (Fig. 20a-i) and the colouration and shape of the siphunculi (Fig. 21a-i).

3.2.2. Description

Drepanosiphum latifemorum sp. n.

(Fig. 22; Table 3).

Type material. Holotype Morocco, Ifrane, 1665 m, one alate viviparous female, *A. monspessulanum*, 11.VIII.1938, Mimeur, MNHN (EH) 22498. **Paratypes** Nine slides with alate viviparous females: MNHN (EH) 22494, 22495, 22496, 22497, 22500, 22501, the same data as the holotype; MNHN (EH) 22499, 22502, 22503 Morocco, Ifrane, 1665 m, *A. monspessulanum*, 30.VIII.1938, Mimeur.

Alate viviparous female (n=10). **Pigmentation.** Colour of live specimens: unknown; mounted specimens: yellowish with slightly pigmented knee areas and apices of siphunculi. Veins of fore wings brown (Fig. 19h). **Morphometric characters. Body** elongate. **Head** (Fig. 22a) with large compound eyes, triommatidia and three ocelli. Frons flat with well-developed, smooth and diverging antennal tubercles. **Antennae** 6-segmented, imbricated, with very short, almost transparent setae. ANT 1.11-1.67 x BL and 1.79-1.84 x HW. ANT I square-shaped. ANT II rectangle. ANT III wider at base and slightly narrower at apex with 11-17 oval, ciliated rhinaria distributed in row on basal 1/3 part (Fig. 22c). ANT IV longer than ANT V. ANT V with one large and ciliated primary rhinarium at the apex. BASE with one major, ciliated rhinarium and six accessory rhinaria; proximal and distal ones almost as large as or slightly smaller than primary rhinarium, others accessory rhinaria situated in the area of major rhinarium – two distal ones are very small and located very close to each other (Fig. 18g). ANT I with 2-8 setae, ANT II with 3-4 setae, ANT III with 41-56 setae, ANT IV with 18-26 setae, ANT V with 9-13 setae. PT with one basal and four apical setae. PT 4.69-6.78 x BASE; other antennal ratios: VI:III 0.73-1.01, V:III 0.57-0.74, IV:III 0.68-0.80. **Rostrum** reaching mesosternum. ARS short with slightly blunt apical part with two primary setae and 9 accessory setae, 0.1-0.13 x ANT III and 0.80-1.30 x HT II. **Legs** long, setosae. Fore femora

(Fig. 22e) enlarged, distinctly thicker than mid- (Fig. 22f) and hind femora, femurs ratios I:II (width of FI:FII) 1.51-1.67. Tibiae with transverse rows of short spinules, long, erect pointed setae on distal part and 5 rastral spines. Empodial setae spatulate. **Fore wings** typical, with normal venation; radius strongly curved, media with three branches. Area between media and cubitus only at the edge of the wing with minute scales, triangular, larges ones only and the tips of branches of veins (Fig. 22b). Hind wings with two oblique veins. **Abdomen** without any traces of sclerotisation, including single black sclerite in front of each of the siphunculi (Fig. 22d). Abdominal tergites with fine and pointed setae in spinal, pleural and marginal position 0.08-0.1 mm long, among them numerous 0.03-0.05 mm long setae. **Siphunculi** tubular, slightly curved at base with well-developed flange and wrinkled surface. **Cauda** knobbed, with five fine and pointed setae.

Remarks: Among the species of the genus *Drepanosiphum* that are known to date, *D. oregonensis* and *D. latifemorum* sp. n. are characterised by fore femora that are extremely enlarged, more than 1.5 x thicker than the mid- and hind femora (in *D. latifemorum* sp. n. up to 1.67). The new species can be distinguished from *D. oregonensis* by the general colouration of the body, which is pale; no trace of a ventral brown or black stripe on the hind femora; a black sclerites in front of each of the siphunculi; the pigmentation of the basal part of antennal segment III; the distribution of minute scales on the fore wings; the ratios of ARS:HTII, which are less than 0.75 (in *D. oregonensis* they are more than 0.75) and much shorter dorsal setae (in *D. latifemorum* sp. n. less than 0.1 mm long, in *D. oregonensis* more than 1.1 mm long).

Etymology: The name of the new species comes from the enlarged fore femora and is derived from the Latin: “*latus*” wide (gender neuter) and “*femur*” (gender neuter).

Distribution and host plants: The species is only known from Morocco, Ifrane 1665 m.a.s.l. (MNHN, ex coll. Mimeur) and the only known host tree is *Acer monspessulanum monspessulanum*.

3.2.3. Key to species of *Drepanosiphum* based on winged viviparous females

1. Fore wing with a dusky patch at tip between ends of Rs and M1.....*D. aceris* Koch
 - Fore wing sometimes with dusky spots at ends of veins, but not with pigment extending between vein endings.....**2**
2. SIPH tapering gradually from base to apex, rarely with any discernible swelling. Pterostigma of forewing with a characteristically shaped dark band, thickened near its proximal end. ANT III with less than 12 rhinaria.....*D. braggii* Gillette
 - SIPH with at least a slight swelling of middle region. Pterostigma of forewing pale, or with either a uniformly thin dark band or a dark distal patch. ANT III usually with more than 12 rhinaria.....**3**
3. Dorsal abdomen with two broad, dark, transverse bands on segments 4 and 5, that on segment 5 extending laterally to almost touch the marginal sclerites in front of the SIPH. Pterostigma with a small dark patch at its distal extremity. Often brachypterous or with short wings.....*D. dixonii* Hille Ris Lambers
 - Dorsal abdomen either without transverse bars or with more, shorter, bars not extending to marginal sclerites. Pterostigma without any distinct small dark patch. Always fully winged.....**4**
4. Fore femora more than 1.5× thicker than mid- and hind femora.**5**
 - Fore femora less than 1.5× thicker than mid- and hind femora.....**6**
5. Fore femora with a very distinct broad black longitudinal ventral stripe. ANT III with a short black contrasting section near base, as dark as the apex of the segment. Whole area of

fore wings covered by minute scales. ARS:HTII more than
0.75.....*D. oregonensis* Granovsky

- Fore femora without broad black longitudinal ventral stripe. ANT III uniformly pale. Area
between media and cubitus only at the edge of the wing with minute scales with largest ones
and the tips of branches of veins. ARS:HTII less than
0.75.....*D. latifemorum* sp. n.

6. PT less than $0.7 \times \text{ANT III}$, PT:BASE 6.0-7.0. R IV+V at least 0.14 mm. BL 3.1-4.3 mm.
With or without a black patch in front of each SIPH.....7

- PT more than $0.7 \times \text{ANT III}$, PT:BASE 7.5-12.0. R IV+V less than 0.14 mm. BL 2.1-3.3
mm. With a black patch in front of each SIPH.....8

7. *Either* with no dorsal or marginal abdominal markings (spring/summer) *or* with a series
of brown-black transverse dorsal bars and marginal sclerites including a large black ante-
siphuncular sclerite (autumn).....*D. platanoidis* (Schrank)

- Always with a single black sclerite just in front of each SIPH, even in specimens without
dorsal abdominal bars.....*D. iranicum* Hille Ris Lambers

8. SIPH with conspicuously dark tips, even in very pale specimens, and often wholly dusky
or dark. ANT III with 9-15 rhinaria.....*D. acerinum* (Walker)

- SIPH usually pale, without conspicuously dark tips. ANT III with 15-26
rhinaria.....*D. caucasicum* Dzhibladze

4. Discussion

Generally, the most important diagnostic characters of the winged viviparous females of the
genus *Drepanosiphum* include: the colouration of the third antennal segment and the number
of rhinaria, the number and arrangement of the accessory rhinaria of the basal part of antennal
segment VI, the pigmentation of the pterostigma and the distribution of minute scales on the

1 fore wings, the colouration of the hind tibiae and tarsi, as well as the shape and pigmentation
2 of the siphunculi. Among the species of the genus that was studied, it is easy to distinguish *D.*
3
4 *aceris*, *D. braggi* and *D. dixonii* by comparing those characters (Figs 17-21). The mentioned
5
6 species are monophagous (Nearctic *D. braggi* is recorded from *A. negundo*) or narrow
7
8 oligophagous (Palearctic *D. aceris* and *D. dixonii* are associated with *A. campestre* or *A.*
9
10 *pseudoplatanus*).

11
12 The black stripe on the fore femur, which is much thicker than the hind one, and the black
13
14 basal section of the third antennal segment are distinctive characters of *D. oregonensis*. For
15
16 this reason, the latter can easily be distinguished from *D. latifemorum* sp. n., but the most
17
18 significant character of the new species are the enlarged fore femora, which are the thickest
19
20 among the species of the genus *Drepanosiphum* that have been described to date. *D.*
21
22 *oregonensis* is a Palearctic species that was introduced into North and South America (Ortego
23
24 et al., 2014), which is associated with about 11 species of *Acer* spp. *D. latifemorum* sp. n. on
25
26 the other hand is known only from its type locality and *Acer m. monspessulanum*.

27
28 However, in the case of pairs of species *D. acerinum* vs *D. caucasicum* and *D. iranikum* vs *D.*
29
30 *platanoidis* their proper determination can be difficult and the identity of those species is in
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32 doubt. A reinvestigation of the type material of *D. acerinum* and *D. caucasicum* clearly shows
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34 that in addition to the differentiating characters that were listed in the original description
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36 (Dzhibladze, 1962) and Blackman and Eastop's general key to the species that are associated
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38 with *Acer* spp. (2015), these species can be easily separated by the differences in the number
39
40 and arrangement of the accessory rhinaria of the basal part of antennal segment VI (Fig. 17a,
41
42 b) and the pigmentation of the hind legs (Fig. 20a, b). The different host relationships (*D.*
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44 *acerinum* is associated with *Acer campestre*, *A. ibericum*, *A. monspessulanum*, *A. obtusatum*,
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46 *A. platanoides*, *A. pseudoplatanus* and *A. tataricum* whereas *D. caucasicum* with *A. hyrcanum*
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48 subsp. *tauricolum* and *A. trautvetteri* Holman, 2009) also indicate that those are separate
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species. *D. acerinum* is widely distributed but not common European species, and is a vector of Maple leaf perforation virus (Sutaková, 1984), which could be a problem for ornamental varieties. *D. caucasicum*, on the other hand, seems to be a montane element that is locally distributed with its host plants in the subalpine zone at 2.000-2.500 m a.s.l. in the refugial forests of the Caucasus.

D. platanoidis is the widely distributed and one the most studied tree-dwelling aphid species (Dixon, 1966, 1969, 1990; Simpson, 2013), treated as sycamore (*Acer pseudoplatanus*) pests and may cause damage in forests and ornamental trees and shrubs (Dixon, 1971; Milevoj and Cravanja, 1999; Thorpe et al., 2004; Gotlin Čuljak et al., 2006; Kollar et al., 2009; Alford, 2012). In comparison to other representatives of the genus *Drepanosiphum*, this species represents different a reproductive strategy. *D. platanoidis* enters reproductive diapause as an adult during the summer, migrates vertically down into the lower canopy of sycamores and aggregates on leaves in the shade. In the spring and autumn seasons, it is abundant and active (Dixon, 1998). This is also reflected in the different abdominal sclerotisation patterns of spring/summer (without sclerites including single black sclerite in front of each of the siphunculi) and autumn (with dorsal cross bars and marginal sclerites including a black one in front of each of the siphunculi) winged viviparous females (Dixon, 1972). *D. iranicum*, which was described as a subspecies of the latter, is characterised by the absence of abdominal sclerites and the presence of a single black sclerite in front of each of the siphunculi and probably continues to reproduce throughout the summer on its host plants. Generally, individuals of this species are larger and have longer antennae, legs and siphunculi than *D. platanoidis*; another important key character is the distribution of minute scales on the fore wings (Fig. 19d, e). *D. iranicum* is known from few localities in Iran – Karaj, Chaloos (Hille Ris Lambers, 1971), Teheran (Rezwani, 1987; BMNH), Bagh-e Nari (MNHN) and is mostly associated with *A. cappadocicum* or *A. vetulinum*, and has occasionally been collected from *A.*

pseudoplatanus (specimens from the MNHN collection). *D. platanoidis*, on the other hand, is recorded from about 20 species of *Acer* spp., but its main host plant is the sycamore. *A. pseudoplatanus* is an ornamental plant that is commonly cultivated outside its natural range in Europe and southwest Asia. It has naturalised at many locations and is recognised as a bushland weed in Tasmania, Victoria South Australia, the Qenolan area of New South Wales (Csurhes and Edwards, 1998) and New Zealand (Howell, 2008). The sycamore is considered to be an invasive species and causes many ecological problems due to its fast growth rate, adaptability and high levels of seed production in the areas where it is introduced. However, it can also support a high biodiversity, including other aphid species and *D. platanoidis* (Leslie, 2005). It is a potential timber crop for farm forestry sites and enhances the biodiversity and landscape of the holding and is encouraged by UK governmental policy (Wong et al., 2015). Across Europe its economic and ecological values are increasingly being considered to be worthy of investment (Hein et al., 2009), so its aphidofauna should be precisely known.

The winged males are similar in general morphology to the viviparous females with the exception of the secondary rhinaria on antennal segments III-V and the characters of the genitalia. Oviparous females, the only wingless adult morphs in the genus that was studied, are characterised by the high variability in the shape and number of their dorsal setae as well as the presence of pseudosensoria on the hind tibiae, which is of diagnostic value.

Because sexuales are known in almost all of the species of the genus *Drepanosiphum* (they only remain unknown in *D. caucasicum* and *D. latifemorum* sp. n.), their characteristics could be considered to be both diagnostic and a species identity value. In particular, in the case of the pair of species *D. iranicum* vs *D. platanoidis*, the length and shape of the abdominal setae of oviparous females as well as the distribution of the minute scales on the fore wings and the number of accessory rhinaria on antennal segment V clearly show differences among the taxa

that were studied. The characters of the male genitalia of aphids have an undisputed value in the taxonomy of this group of insects (Depa et al., 2015; Kanturski and Wieczorek, 2014; Wieczorek et al., 2011, 2012, 2014). However, in all of the representatives of the genus that was studied, the components of the male genital apparatus are quite similar across species (Fig. 15), i.e. *D. aceris*, *D. braggi*, *D. iranicum*, *D. oregonensis* and *D. platanoidis* have rather large, lobate parameres and a short, robust basal part of the phallus. In *D. acerinum* and *D. dixonii* the parameres are rather small whereas the basal part of the phallus is thin and elongated. The latter species is also characterised by the most robust sclerotised arms of the basal part of the phallus.

The copulatory behaviour of aphids that belong to the genus *Depanosiphum* has rarely been investigated and is mainly related to the sycamore aphid (Dixon, 1963; Kozłowski, 1991; Leather et al., 2005). Sexuales were observed on the underside of the leaves of small twigs of their host plants (Fig. 16).

Our research is an example that the comparative morphological study of winged viviparous females in conjunction with analyses of the characters of sexual generation is a useful method for demonstrating the differences between closely related taxa. In particular, in closely related aphid species in the genus *Drepanosiphum* (present study) or in other genera (Barjadze et al., 2014; Nieto Nafria and Pérez Hidalgo, 2014; Nieto Nafria et al., 2015, 2014), for which quantitative characters overlap between species, and more useful discriminant characters are qualitative ones.

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26 **Figure legends:**

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29 Table 1 Measurements (in mm) of main characters of oviparous females of the genus
30 *Drepanosiphum*.
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34 Table 2 Measurements (in mm) of main characters of males of the genus *Drepanosiphum*.
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37 Table 3 Measurements (in mm) of main characters of viviparous females of *Drepanosiphum*
38 *latifemorum* sp. n.
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44 Fig. 1. *Drepanosiphum acerinum* – oviparous female: (a) general view, (b) antennal segment
45 III, (c) hind tibia with pseudosensoria, (d) blunt seta of abdominal tergite V, (e) forked seta of
46 abdominal tergite V, (f) pointed seta of abdominal tergite VII, (g) siphunculus.
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51 Fig. 2. *Drepanosiphum acerinum* – male: (a) head, (b) fore wing, (c) antennal segment III, (d)
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Fig. 3. *Drepanosiphum aceris* – oviparous female: (a) general view, (b) antennal segment III, (c) hind tibia with pseudosensoria, (d) forked seta of abdominal tergite V, (e) pointed seta of abdominal tergite VII, (f) siphunculus.

Fig. 4. *Drepanosiphum aceris* – male: (a) head, (b) fore wing, (c) antennal segment III, (d) abdomen.

Fig. 5. *Drepanosiphum braggii* – oviparous female: (a) general view, (b) antennal segment III, (c) hind tibia with pseudosensoria, (d) forked seta of abdominal tergite V, (e) blunt seta of abdominal tergite VII, (f) siphunculus.

Fig. 6. *Drepanosiphum braggii* – male: (a) head, (b) fore wing, (c) antennal segment III, (d) abdomen.

Fig. 7. *Drepanosiphum dixonii* – oviparous female: (a) general view, (b) antennal segment III, (c) hind tibia with pseudosensoria, (d) forked seta of abdominal tergite VII, (e) spatulate seta of abdominal tergite V, (f) siphunculus.

Fig. 8. *Drepanosiphum dixonii* – male: (a) head, (b) fore wing, (c) antennal segment III, (d) abdomen.

Fig. 9. *Drepanosiphum iranicum* – oviparous female: (a) general view, (b) antennal segment III, (c) hind tibia with pseudosensoria, (d) forked seta of abdominal tergite V, (e) club-shaped seta of abdominal tergite VI, (f) pointed seta of abdominal tergite VII, (g) siphunculus.

Fig. 10. *Drepanosiphum iranicum* – male: (a) head, (b) fore wing, (c) antennal segment III, (d) abdomen.

Fig. 11. *Drepanosiphum oregonensis* – oviparous female: (a) general view, (b) antennal segment III, (c) hind tibia with pseudosensoria, (d) pointed seta of abdominal tergite VII, (e) forked seta of abdominal tergite V, (f) siphunculus.

Fig. 12. *Drepanosiphum oregonensis* – male: (a) head, (b) fore wing, (c) antennal segment III, (d) abdomen.

Fig. 13. *Drepanosiphum platanoidis* – oviparous female: (a) general view, (b) antennal segment III, (c) hind tibia with pseudosensoria, (d) pointed seta of abdominal tergite VII, (e) capitate seta of abdominal tergite V, (f) forked seta of abdominal tergite VI, (g) siphunculus.

Fig. 14. *Drepanosiphum platanoidis* – male: (a) head, (b) fore wing, (c) antennal segment III, (d) abdomen.

Fig. 15. The characters of the male genitalia: (a) *D. acerinum* LM, (b) *D. aceris* LM, (c) *D. braggii* LM, (d) *D. dixonii* LM, (e) *D. iranikum* LM, (f) *D. iranikum* SEM (g) *D. oregonensis* LM, (h) *D. platanoidis* LM; (i) *D. platanoidis* SEM. p-parameres, bp-basal part of the phallus with sclerotised arms that consist of a short proximal (solid arrow) and long distal (dotted arrow) part, a-aedeagus; light microscopy LM, scanning electron microscopy SEM.

Fig. 16. *D. platanoidis* viviparous and oviparous of the autumn generation: (a) viviparous female and male, (b) oviparous females, (c), (d) sexuales-copulation.

Fig. 17. The number and arrangement of the accessory rhinaria on antennal segment III – alate viviparous female: (a) *D. acerinum*, (b) *D. caucasicum*, (c) *D. aceris*, (d) *D. platanoidis*, (e) *D. iranikum*, (f) *D. braggii*, (g) *D. oregonensis*, (h) *D. latifemorum* sp. n., (i) *D. dixonii*.

Fig. 18. The number and arrangement of the accessory rhinaria on the basal part of antennal segment VI – alate viviparous female: (a) *D. acerinum*, (b) *D. caucasicum*, (c) *D. aceris*, (d) *D. platanoidis*, (e) *D. iranikum*, (f) *D. braggii*, (g) *D. oregonensis*, (h) *D. latifemorum* sp. n., (i) *D. dixonii*.

Fig. 19. Fore wings – alate viviparous female: (a) *D. acerinum*, (b) *D. caucasicum*, (c) *D. aceris*, (d) *D. platanoidis*, (e) *D. iranikum*, (f) *D. braggii*, (g) *D. oregonensis*, (h) *D. latifemorum* sp. n., (i) *D. dixonii*.

Fig. 20. Hind legs – alate viviparous female: (a) *D. acerinum*, (b) *D. caucasicum*, (c) *D. aceris*, (d) *D. platanoidis*, (e) *D. iranikum*, (f) *D. braggii*, (g) *D. oregonensis*, (h) *D. latifemorum* sp. n., (i) *D. dixonii*.

Fig. 21. Siphunculi – alate viviparous female: (a) *D. acerinum*, (b) *D. caucasicum*, (c) *D. aceris*,
(d) *D. platanoidis*, (e) *D. iranikum*, (f) *D. braggii*, (g) *D. oregonensis*, (h) *D. latifemorum* sp. n.,
(i) *D. dixonii*.

Fig. 22. *Drepanosiphum latifemorum* sp. n. – alate viviparous female: (a) head, (b) fore
wings, (c) antennal segment III, (d) abdomen, (e) fore femur, (f) mid femur.

Table 1

Character	<i>D. acerinum</i> n=4	<i>D. aceris</i> n=8	<i>D. braggii</i> n=7	<i>D. dixonii</i> n=1	<i>D. iranicum</i> n=10	<i>D. oregonensis</i> n=2	<i>D. platanoidis</i> n=10
BL	2.77-3.03	2.50-3.25	2.75-3.67	2.70	3.25-4.25	2.37	3.27-3.77
BW	1.15-1.25	0.51-0.66	1.00-1.37	1.15	1.20-1.70	0.90	1.12-1.47
HW	0.58-0.60	0.51-0.66	0.68-0.74	0.64	0.69-0.72	0.68	0.60-0.73
ANT	3.41-3.54	3.48-3.55	5.33-5.82	4.02-4.07	4.15-4.95	3.01-3.03	0.83-1.32
ANT III	0.83-0.94	1.00-1.02	1.10-1.30	1.00-1.02	1.12-1.52	0.69-0.70	0.83-1.32
ANT IV	0.65-0.82	0.70-0.74	1.00-1.25	0.91-0.95	0.90-1.20	0.57-0.60	0.63-0.92
ANT V	0.68-0.81	0.62-0.67	1.02-1.15	0.82-0.85	0.80-1.00	0.54-0.58	0.61-0.85
ANT VI	1.03-1.095	0.87-0.97	1.81-2.09	0.96-1.06	0.89-1.10	0.97-0.98	0.82-1.08
BASE	0.13-0.14	0.12-0.13	0.15-0.18	0.16	0.13-0.15	0.12-0.13	0.11-0.14
PT	0.90-0.96	0.75-0.85	1.65-1.92	0.80-0.90	0.76-0.95	0.84-0.86	0.71-0.94
ARS	0.10-0.11	0.14	0.14-0.18	0.14	0.16-0.17	0.10	0.14-0.15
FEMORA III	0.80-0.82	0.95-0.97	1.07-1.25	0.87-0.90	1.25-1.35	0.72-0.74	1.20-1.30
TIBIA III	1.30-1.42	1.65-1.72	2.05-2.37	1.65-1.70	2.17-2.45	1.20-1.22	2.20-2.40
HT II	0.15-0.16	0.18-0.19	0.16-0.18	0.14-0.15	0.17-0.21	0.15-0.16	0.14-0.20

Table 1 Measurements (in mm) of main characters of oviparous females of the genus *Drepanosiphum*.

Table 2

Character	<i>D. acerinum</i> n=3	<i>D. aceris</i> n=3	<i>D. braggii</i> n=2	<i>D. dixonii</i> n=1	<i>D. iranicum</i> n=4	<i>D. oregonensis</i> n=2	<i>D. platanoidis</i> n=10
BL	2.10-2.50	2.37-3.00	2.55-2.90	2.5	2.70-3.50	2.55-2.67	2.67-3.55
BW	0.75-0.72	0.95-1.00	0.75-0.82	1.00	0.75-1.02	0.75-0.80	1.00-1.10
HW	0.51-0.55	0.50-0.64	0.62-0.63	0.60	0.64-0.70	0.56-0.59	0.60-0.71
ANT	3.92-4.25	4.92-5.42	4.82-5.08	5.02-5.16	4.08-4.99	3.53-3.81	3.74-4.75
ANT III	1.02-1.20	1.27-1.32	1.10-1.12	1.32-1.35	1.52-1.62	0.95-1.01	1.00-1.45
ANT IV	0.70-0.87	1.05-1.15	0.90-0.95	1.02-1.05	1.05-1.20	0.71-0.72	0.80-1.07
ANT V	0.74-0.81	1.01-1.02	0.94-1.00	1.02-1.07	0.91-1.05	0.65-0.73	0.69-1.02
ANT VI	1.26	1.34-1.66	1.59-1.70	1.41-1.42	0.94-1.03	1.05-1.16	0.94-1.27
BASE	0.14	0.14	0.14-0.15	0.15-0.16	0.13-0.17	0.13-0.14	0.11-0.16
PT	1.12	1.20-1.52	1.45-1.55	1.25-1.27	0.79-0.90	0.92-1.02	0.82-1.12
ARS	0.09-0.10	0.14-0.15	0.14	0.14	0.15-0.16	0.10	0.13-0.15
FEMORA III	0.82-0.85	0.12-0.17	0.95-1.00	1.07-1.08	0.15-0.32	0.80-0.85	0.90-1.10
TIBIA III	1.45-1.60	2.27-2.50	1.95-2.12	1.20-2.00	2.20-2.35	1.52-1.57	1.90-2.15
HT II	0.13-0.14	0.14-0.15	0.16	0.14-0.15	0.16-0.18	0.15-0.16	0.17-0.19

Table 2 Measurements (in mm) of main characters of males of the genus *Drepanosiphum*.

Table 3

Character	<i>Drepanosiphum latifemorum</i> sp. n. (n=8)							
BL	3.15	2.96	2.90	2.67	2.55	2.48	3.21	2.40
BW	1.25	1.20	1.25	0.80	0.95	0.98	1.25	1.00
ANT	3.51	4.01	3.82	3.98	4.02	3.42	4.12	4.00
ANT III	1.20	1.13	1.20	1.20	1.16	1.05	1.08	1.24
ANT IV	0.94	0.89	0.81	0.95	0.85	0.73	0.86	0.95
ANT V	0.79	0.74	0.72	0.76	0.72	0.60	0.80	0.78
BASE	0.15	0.15	0.14	0.14	0.15	0.13	0.14	0.16
PT	0.76	0.89	0.95	0.75	0.80	0.75	0.95	0.75
ARS	0.13	0.12	0.12	0.13	0.12	0.13	0.13	0.12
FEMORA IL	1.05	1.00	0.90	0.97	0.95	0.85	1.00	1.00
FEMORA IW	0.21	0.20	0.21	0.20	0.20	0.20	0.20	0.20
FEMORA IIL	0.80	0.74	0.75	0.74	0.62	0.82	0.70	0.75
FEMORA IIW	0.14	0.13	0.14	0.13	0.12	0.12	0.13	0.13
FEMORA IIIL	1.00	0.90	0.95	0.87	0.87	0.85	0.92	0.87
TIBIA III	1.95	1.82	1.82	1.80	1.65	1.50	1.75	1.67
HT II	0.16	0.15	0.13	0.16	0.15	0.10	0.15	0.15
Siphunculus	0.79	0.72	0.77	0.64	0.70	0.62	0.74	0.75
Fore wings L	4.00	4.12	3.90	3.75	3.62	3.25	4.00	3.75
Fore wings W	1.35	1.35	1.25	1.20	1.15	1.00	1.40	1.17

Table 3 Measurements (in mm) of main characters of viviparous females of *Drepanosiphum latifemorum* sp. n.

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 7

Figure 8

Figure 9

Figure 10

Figure 11

Figure 12

Figure 13

Figure 14

Figure 15

Figure 16

Figure 17

Figure 18

Figure 19

Figure 20

Figure 21

Figure 22