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Approaches to classification of drepanosiphidae aphids (*Hemiptera, Aphidoidea: Drepanosiphidae*)

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Introduction

The *Drepanosiphidae* are one of the most numerous and most diversified aphid groups, the classification of which is still controversial and unsolved, which is manifested by unrestricted inclusion of particular taxons into its ranks. The lack of agreement is concerned with the range of taxons, especially on the level of the subfamily and tribes because most often intuitive classification is used on the basis of general morphology of these aphids with no proofs of proper phylogenetic connections. According to different authors it can be divided into 3 (HEIE, 1980), 12 (QUEDNAU, 1999, 2003) or 14 subfamilies (QUEDNAU & REMAUDIERE, 1994). The following are also highly debatable: the range of *Phyllaphidinae* subfamily as well as the affinity between *Drepanosiphinae* and *Chaitophorinae* which are often considered to be sister groups.

This paper reviews views on the classification of drepanosiphidae aphids, the importance and range of its particular taxons and criteria used in its identification.

The *Drepanosiphidae* (Drepanosiphiden) is the oldest known name of this group of aphids with *Drepanosiphum* Koch, 1855 being its typical genus and *Phyllaphididae* (Phyllaphiden) with *Phyllaphis* Koch, 1857 being its typical genus as described by KOCH and published by D. Herrich-Schaeffer (1854-1857). A third name formed in this publication – *Callipteridae* (Callipteriden) is incorrect because a typical genus *Callipterus* Koch, 1855 is a younger homo-

nym of *Callipterus* Agassis, 1846, which is not aphid and *Callipterus* Koch was changed into *Callaphis* Walker, 1870. This name, however, was commonly used by many authors.

In Polish aphidological writing the name drepanosiphidae aphids ('zdobniczkowate') was first used by SZELEGIEWICZ (1978) to refer to the *Phyllaphididae* family and derives from the genus name *Phyllaphis* s. l. However, to name the *Chaitophoridae* family in the same publication SZELEGIEWICZ used a name 'włochatkowate', which derives from the name of genus *Chaitophorus* s. l. – 'włochatka' (RUSZKOWSKI & RUSZKOWSKI, 1998).

As knowledge and description of the new genera and species improved the general classification of aphids underwent changes – MORDVILKO (1908) lifts aphids to a level of family (*Aphididae*) which is divided into 3 subfamilies: *Phylloxerinae, Pemphiginae* and *Aphidinae*. In the latter subfamily the following genera are included: *Callipterus* and *Phyllaphis* (*Callipterin*a tribe), *Drepanosiphum* (*Aphidina* tribe), and for the first time *Chaitophori* group is formed with *Chaitophorus* Koch as its typical genus, placing these aphids in the *Aphidina* tribe.

VAN DER GOOT (1913) with reference to classification by MORDVILKO (1908) distinguishes a subfamily of viviparous aphids *Aphidinae* out of the *Aphididae* family, with 11 tribes, including *Chaitophorina, Callipterina* and *Drepanosiphina*.

BAKER (1920) was the first one to place the genera of *Drepanosiphum, Callipterus, Phyllaphis* and *Chaitophorus* in the tribe of *Callipterini* (*Aphidoidea, Aphididae, Aphidinae*).

MORDVILKO (1928) distinguishes the *Callipterinae* subfamily, in which he places both *Callipterea and Chaitophorina*.

The mentioned classifications were based mainly on such features of aphids' external body structure as the number of segments of antennae, the presence or lack of siphunculi (cornicles) or the wing veins. BÖRNER (1930) presented a new system of classification (also on the basis of setae on bodies) in the *Homoptera* suborder highlighting the *Aphidina* superfamily, *Aphididae* family and *Aphidinae* subfamily along with *Chaitophorini* and *Callipterini* tribes. The latter one was divided into *Saltusaphidina* and *Callipterina* with *Drepanosiphum*, *Callipterus* and *Phyllaphis* genera. In the classification of 1952 he clearly separates between these two tribes attributing to them the level of families: *Chaitophoridae* (2 subfamilies – *Chaitophorinae* and *Siphinae*) and *Callaphididae* (4 subfamilies – *Phyllaphidinae, Callaphidinae, Therioaphidinae* and *Saltusaphidinae*). The same system of classification of drepanosiphine aphids was followed by BÖRNER & HEINZE in 1957.

BODENHEIMER & SWIRSKI (1957) on the basis of BAKER'S system (1920) once again join these two aphid groups into the *Callipteridae* family with *Chaitophorinae* (*Chaitophorini, Siphini*) and *Callipterinae* (*Drepanosiphonini, Phyllaphidini, Callipterini, Saltusaphidini, Therioaphidini*) subfamilies.

SHAPOSHNIKOV (1964) when studying the aphids of the European part of the USSR distinguishes 9 families within the *Aphidoidea* superfamily, including the *Chaitophoridae* and *Callaphididae*.

EASTOP (1966), in a monograph devoted to aphids of Australia diversifies between the superfamily *Aphidoidea* into 2 families: *Pemphigidae* and *Aphididae* with 5 subfamilies including *Chaitophorinae* and *Drepanosiphinae* (tribes: *Saltusaphidini* with *Tripsaphis* genus; *Neophyllaphidini* with genera *Ceriferella* and *Neophyllaphis*; *Drepanosiphini* with *Drepanosiphum, Euceraphis, Kallistaphis, Myzocallis, Phyllaphis, Sensoriaphis, Takecallis, Tinocallis* genera). In a paper on the significance of aphids as virus vectors, which also considers their distribution and host plants (1977) he distinguishes only 1 family of *Aphididae* with 12 subfamilies. *Chaitophorinae* and *Drepanosiphinae* constitute separate subfamilies, the latter one being diversified into a range of tribes: *Phyllaphidini, Macropodaphidini, Drepanosiphini, Lizeriini* (=*Paeolliellini*), *Neuquenaphidini* (=*Spicaphidini*), *Mindarini, Neophyllaphidini, Thelaxini, Saltusaphidini.*

In the classification of *Aphididae*, presented by REMAUDIERE & STROYAN (1984), which divides aphids into 20 subfamilies, the extent of *Phyllaphidinae* refers to the classification by EASTOP (1977) excluding the tribes: *Macropodaphidini*, *Drepanosiphini, Lizeriini* and *Mindarini* and attributes them with the level of subfamilies: *Macropodaphidinae, Drepanosiphinae* with the following genera: *Drepanosiphum, Drepanaphis, Drepanosiphoniella* and *Yamatocallis; Lizeriinae* with genera *Lizerius, Paoliella, Pterasthenia, Antalus* and *Mindarinae, Chaitophorinae* also have the level of a subfamily. The authors do not provide any criteria of such a division, though.

Among newer systems the classification presented by HEIE (1987) there seems to be an exception which constructs his division of aphids on the basis of phylogenetic features (plesiomorphies and apomorphies). Within the *Drepanosiphidae* family (1980) he distinguishes 3 subfamilies: *Drepanosiphinae* Herrich-Schaeffer in Koch, 1857; *Phyllaphidinae* Herrich-Schaeffer in Koch, 1857 and *Chaitophorinae* Mordvilko, 1906. The *Phyllaphidinae* subfamily is diversified into 3 tribes: *Phyllaphidini* Herrich-Schaeffer in Koch, *Macropodaphidini* Aizenberg, 1960 and *Saltusaphidini* Baker, 1920. Further division of the *Phyllaphidini* into 3 subtribes refers to the subfamilies from the systematic classification of aphids as presented by BÖRNER (1952).

QUEDNAU & REMAUDIERE (1994) present a different view on classification of this group of aphids as they show phylogenetic links of the *Neuquenaphidinae* subfamily with the remaining drepanosiphines which includes: *Mindarinae, Neophyllaphidinae, Israelaphidinae, Lizeriinae, Taiwanaphidinae, Parachaitophorinae, Pterastheniinae, Phyllaphidinae, Neuquenaphidinae, Macropodaphidinae, Drepanosiphinae, Chaitophorinae, Saltusaphidinae, Myzocallidinae.*

A direct reference to this publication as well as an earlier division by REMAUDIERE & STROYAN (1984) is seen in a consideration of drepanosiphine aphids in the Aphid Catalogue by REMAUDIERE & REMAUDIERE (1997), where the authors establish a number of subfamilies (in classification by HEIE, 1980 they have the level of a tribe within the *Drepanosiphinae* and *Phyllaphidinae* subfamilies and *Drepanosiphidae* family). In this paper the *Phyllaphidinae* subfamily embraces only 4 genera – *Diphyllaphis* Takahashi, 1960; *Machillaphis* Takahashi, 1960; *Phyllaphis* Koch, 1856 and *Stegophylla* Oestlund, 1922. Aphid genera traditionally belonging to the *Phyllaphidinae* or *Callaphidinae* are placed in *Myzocallidinae Calaphidini* and *Myzocallidinae Myzocallidini.*

However, QUEDNAU (1999; 2003) in reference to the classification of aphids as presented by REMAUDIERE & REMAUDIERE (1997), considers 12 subfamilies as belonging to drepanosiphine aphids (*Mindarina* Tullgren, 1909; *Neophyllaphidinae* Takahashi, 1921; *Lizeriinae* Blanchard, 1923; *Israelaphidinae* Ilharco, 1961; *Taiwanaphidinae* Quednau & Remaudiere, 1994; *Pterastheniinae* Remaudiere & Quednau, 1988; *Spicaphidinae* Essig, 1953; *Macropodaphidinae* Zachvatkin & Aizenberg, 1960; *Saltusaphidinae* Baker, 1920; *Phyllaphidinae* Herrich-Schaeffer in Koch, 1857; *Drepanosiphinae* Herrich-Schaeffer in Koch, 1857; *Calaphidinae* Oestlund, 1919). Among these, the *Calaphidinae* subfamily is the most advanced in terms of evolution (according to the classification by HEIE (1982) the *Phyllaphidini* tribe from the *Phyllaphidinae* subfamily is the respective of this subfamily) and is divided into 65 genera and 2 tribes: *Calaphidini* Oestlund, 1919 and *Panaphidini* Oestlund, 1923 (QUEDNAU, 1999). The analysis of phylogenetic features prompted the author to present the affinity among the *Panaphidini.*

As opposed to the previously mentioned systems of classification as stated by Quednau the term 'drepanosiphine' aphids has a very wide meaning. The terminology of subfamilies is in accordance with the International Code of Zoological Terminology – this refers most of all to the *Calaphidinae* subfamilies, the name of which is usually misused or was used as a synonym (NIETO NAFRIA *et al.*, 1997).

Summary

On the present level of research one may state that the proper use of the division embraces 3 subfamilies in Holoarctic in relation to the *Drepanosiphidae* family: *Drepanosiphinae, Chaitophorinae and Calaphidinae* (*=Phyllaphidinae*). Such a division is confirmed by a study of aphid male reproductive system – there is a clear similarity of its structures in the *Drepanosiphinae* and the *Chaitophorinae* (KLIMASZEWSKI *et al.*, 1973; WIECZOREK & WOJCIECHOWSKI, 2004) and in the representatives of the *Calaphidinae*, especially in relation to *Calaphidini* and *Panaphidini* tribes (WIECZOREK, 2006). Moreover, the structure of

aphid male reproductive system in *Phyllaphis fagi* (Wieczorek, & Świątek, 2007) does not differ from the so far known structures of this system in the *Calaphidinae* representatives.

Further research in terms of morphology (the determination of plesiomorphies and apomorphies), bionomy as well as molecular studies should allow one for the exposition of real phylogenetic links within all the taxons, especially on the level of a subfamily and a tribe.

References

Baker A.C. 1920. Generic classification of the hemipterous family *Aphididae*. Bull. U. S. Dept. Agr. Washington D.C., 826, 109p.

Bodenheimer F.S., Swirski E. 1957. The *Aphidoidea* of the Middle East. The Weizmann Science Press of Israel, Jerusalem, 371p.

Börner C.B. 1930. Beitrage zu einem neuen System der Blattlause. Arch. Klass. Phyl. Ent., Naumburg, 1: 115-194.

Börner C.B. 1952. Europae centralis Aphides. Mitt. Thurin. Bot. Ges. Naumburg, 3, I-II: 484p.

Börner C B., Heinze 1957. *Aphidina-Aphidoidea*. [In:] Sorauer, P. (ed.), Handbuch der Pflanzenkrankheiten, vol. B. Paul Parey, Berlin, 257p.

Eastop V.F. 1966. A taxonomic study of Australian *Aphidoidea*. Austral. J. Zool., 14(3): 399-515.

Eastop V.F. 1977. Worldwide importance of aphids as a virus vectors. [In:] Harris K., Maramorosch K. (eds.) Aphids as a virus vectors. Academic Press, INC. New York, San Francisco, London, 63p.

Heie O.E. 1980. The *Aphidoidea* (*Hemiptera*) of Fennoscandia and Denmark. I. General Part. The families *Mindaridae*, *Hormaphididae, Thelaxidae, Anoeciidae* and *Pemphigidae*. Fauna Entomologica Scandinavica, Sciandinavian Science Press LTD, Klampenborg, Denmark Vol. 9: 235p.

Heie O.E. 1987. Palaeontology and phylogeny. Chapter 6.1. [In:] Minks. A. K. & Harrewijn P. (eds.): Aphids, their biology, natural enemies and control. Elsevier, Amsterdam: 367 – 391.

Klimaszewski S.M., Szelegiewicz H., Wojciechowski W. 1973. Uber den Bau des mannlichen Fortpflanzungssystems von Drepanosiphum platanoidis (Schr.) (*Homoptera, Aphidoidea*). Bulletin de L'Academie Polonaise des Sciences Cl II, 21, 10: 671 – 674.

Koch C.L. 1854-1857. Die Pflanzenlause Aphiden, getreu nach dem Leben abgesildes und beschrieben.I-III. Nornberg, 336p.

Mordvilko A.K. 1908. Tablicy dlja opredelenija grupp i rodov tlej (sem. *Aphididae* PASS.). Ezeg. zool. Muz. A.N. Petrograd, 13: 353-384.

Mordvilko A.K. 1928. *Aphidodea* tli. [In:] Opredelitel nasekomych. Filipiewa (ed.) Novaja derevnja. Moskva, 163-204.

NIETO NAFRIA J.M., MIER DURANTE M.P., REMAUDIERE G. 1997. Les noms des taxa du groupe-famille chez les Aphididae (Hemiptera). Revue fr. Ent. (N.S.), 19 (3-4): 77-92.

QUEDNAU F.W. 1999. Atlas of the Drepanosiphine aphids of the world. Part I *Panaphidini* Oestlund, 1922 *Myzocallidina* Börner 1942 (1930) (*Hemiptera, Aphididae: Callaphidinae*) American Entomological Institute, vol. 31, No.1: 232p.

QUEDNAU F.W. 2003. Atlas of the Drepanosiphine aphids of the world. Part II: *Panaphidini* Oestlund, 1923 – *Panaphidina* Oestlund, 1923 (*Hemiptera, Aphididae: Callaphidinae*) American Entomological Institute, vol. 72: 301p.

QUEDNAU F.W., REMAUDIERE G. 1994. Le genre sud-americain *Neuquenaphis* E.E. Blanchard, description de deux nouvelles especes et definition de nouvelles sous-familles d'Aphididae (*Homoptera*). Bull. Soc. entomol. Fr. 99(4): 365-384.

REMAUDIERE G., STROYAN H. L. G. 1984. Un *Tamalia* nouveau de Californie (USA) et discussion sur les *Tamalinae* subfam. nov. (*Homoptera, Aphididae*). Annales de la Societe Entomologique de France (N.S.) Paris, 20(1): 93-103.

REMAUDIERE G., REMAUDIERE M. 1997. Catalogue of the world's Aphididae (*Homoptera, Aphidoidea*). INRA Editions. Versailles, 473p.

RUSZKOWSKI A., RUSZKOWSKI J. 1998. Słownik polskich nazw owadów. Instytut Sadownictwa i Kwiaciarstwa – Oddział Pszczelnictwa, Puławy, 206p.

SHAPOSHNIKOV G.Kh. 1964. Podotrjad *Aphidinea* tli. [In:] Opredelitel' nasekomych Evropejskoj casti SSSR., Moskwa-Leningrad, t.I: 489-616.

SZELEGIEWICZ H. 1978. Klucze do oznaczania owadów Polski, pluskwiaki równoskrzydłe – *Homoptera*, mszyce *Aphidoidea*. PWN, Warszawa, XVII, 5a: 107p.

VAN DER GOOT P. 1913. Zur Systematik der Aphiden.Tijdschr. Ent., 56: 69-155.

WIECZOREK K. 2006. Anatomical investigations of the male reproductive system of five species of *Calaphidinae* (*Hemiptera, Aphidoidea*). Insect Systematics&Evolution 37: 457-465.

WIECZOREK K., ŚWIĄTEK P. 2007. Classification of the drepanosiphine aphids (*Hemiptera, Aphidoidea: Phyllaphidinae, Calaphidinae*) in the light of the anatomy research. International Journal of Invertebrate Taxonomy-Genus 14: 63-65.

WIECZOREK K., WOJCIECHOWSKI W. 2004. The systematic position of *Chaitophorinae* (*Hemiptera, Aphidoidea*) in the light of anatomy research. Insect Systematics&Evolution 35: 317-327.

Poglądy na klasyfikację mszyc zdobniczkowatych (*Hemiptera, Aphidoidea: Drepanosiphidae*)

Streszczenie

Praca jest artykułem przeglądowym przedstawiającym poglądy na klasyfikację mszyc zdobniczkowatych (*Hemiptera, Aphidoidea: Drepanosiphidae*) – jednej z najliczniejszych i najbardziej zróżnicowanych grup tych pluskwiaków. Przedstawione zostało stanowisko

systematyczne podrodzin *Drepanosiphinae, Calaphidinae, Phyllaphidinae* i *Chaitophorinae* oraz ich zakres w odniesieniu do poglądów różnych autorów. Wskazano również konieczność podjęcia dalszych, szczegółowych badań morfologicznych i molekularnych dla ukazania rzeczywistych powiązań ewolucyjnych wśród tych mszyc.