

A food plant study of the Auchenorrhyncha of the Częstochowa upland, southern Poland

(Insecta, Hemiptera)

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Kurzfassung: Auf der Hochebene von Tschenstochau in Süd-Polen wurde 2004 bis 2006 die Zikadenfauna von 31 Kräuter- und Grasarten untersucht. Das Material umfasst insgesamt 1970 adulte Individuen aus 44 Arten. Für 21 Pflanzenarten werden Zikadengilden beschrieben und diskutiert.

Abstract: Auchenorrhyncha were sampled on 31 species of forbs and grasses in the years 2004-2006 in the area of Częstochowa Upland in southern Poland. Altogether, the material includes 1970 adult individuals belonging to 44 species. Auchenorrhyncha guilds for 21 plants are described and discussed.

Key words: Hemiptera, Auchenorrhyncha guilds, food plants, Poland

1. Introduction

The knowledge of Auchenorrhyncha food plants in Poland, unlike those published recently from Germany (Nickel 2003) or Britain (e.g. Waloff & Solomon 1973; Cook 1996), are far from complete. Smreczyński (1954) and Nast (1976) provided records mainly for arboricolous taxa, i.e. Macropsinae, Idiocerinae, Jassinae and Typhlocybinae, but there is still no information on the food preferences of the bulk of the leafhopper fauna. The aim of this work was to determine Auchenorrhyncha guilds associated with forbs and grasses, which are notable constituents of grasslands on limestone and sandy substrates of the Częstochowa upland in southern Poland.

2. Study area, methods and material

A survey was carried out over a 3-year period (2004-2006) near the villages of Olsztyn and Mstów, UTM CB 72, CB 73 (Fig. 1). This region is characterized by Upper Jurassic limestone formations dissected by valleys filled with Pleistocene sands. Because of the variety of habitats, the vegetation of this area is rather rich, especially in grasslands, which form two major groups – the first one steppe-like on limestone hills and the second one on sandy soils in depressions. Only plant species growing in more or less pure stands were covered. Auchenorrhycha were sampled 6 times during the growing season on 21 forbs of the families Hypericaceae (1 species), Rosaceae (1), Fabacae (3), Apiaceae (1), Asclepiadaceae (1), Rubiaceae (1), Dipsacaceae (1), Boraginaceae (1), Scrophulariaceae (1), Lamiaceae (6) and Asteraceae (4), and on 10 species of grasses (Poaceae). Usually each plant was searched for leafhoppers on 2 or 3 stands. To collect individuals a standard circular sweep-net was used (30 cm in diameter). A leafhopper feeding relationship was assumed after at least 3 positive samples.

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Identification was carried out after Ossiannilsson (1978, 1981, 1983), Holzinger *et al.* (2003) and Biedermann & Niedringhaus (2004).

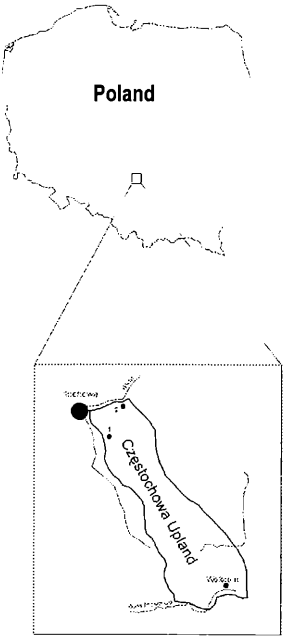

Fig. 1: Location of the study area (1 – Olsztyn, 2 – Mstów).

3. Results

Altogether, the material collected in the years 2004-2006 included 1970 adults, comprising 44 species. So far the investigations have not revealed any Auchenorrhyncha relationship for 9 forbs: *Agrimonia eupatoria*, *Anthyllis vulneraria*, *Coronilla varia*, *Libanotis pyrenaica*, *Scabiosa ochroleuca*, *Echium vulgare*, *Helichrysum arenarium*, *Betonica officinalis*, *Achillea millefolium* and for the grass *Briza media*, although the three last-mentioned species are known as hosts of monophagous leafhoppers from Germany (Nickel 2003).

Regarding the investigated forbs, a constant relationship was recorded for 16 Auchenorrhyncha species (Tab. 1). The highest number of species was recorded for *Trifolium arvense* (*Megophthalmus scanicus*, *Anaceratagallia ribauti*, *Aphrodes bicincta*). Only one species, respectively, was revealed for 7 species of dicots: *Hypericum perforatum* (*Zygina hyperici*), *Vincetoxicum hirundinaria* (*Fieberiella septentrionalis*), *Galium mollugo* (*Cercopis sanguinolenta*), *Verbascum lychnitis* (*Micantulina stigmatipennis*), *Clinopodium vulgare* (*Emelyanoviana mollicula*), *Stachys recta* (*Emelyanoviana mollicula*) and *Thymus pulegioides* (*Erythria aureola*).

Highest abundances (more than 50 individuals) were found in *Emelyanoviana mollicula*, *Chlorita paolii*, *Zygina hyperici* and *Neoaliturus fenestratus*.

The group of Auchenorrhyncha with marked preference for forbs was characterized by high proportions of species which are oligophagous (56%) and hibernate as egg (81%) (Fig. 2).

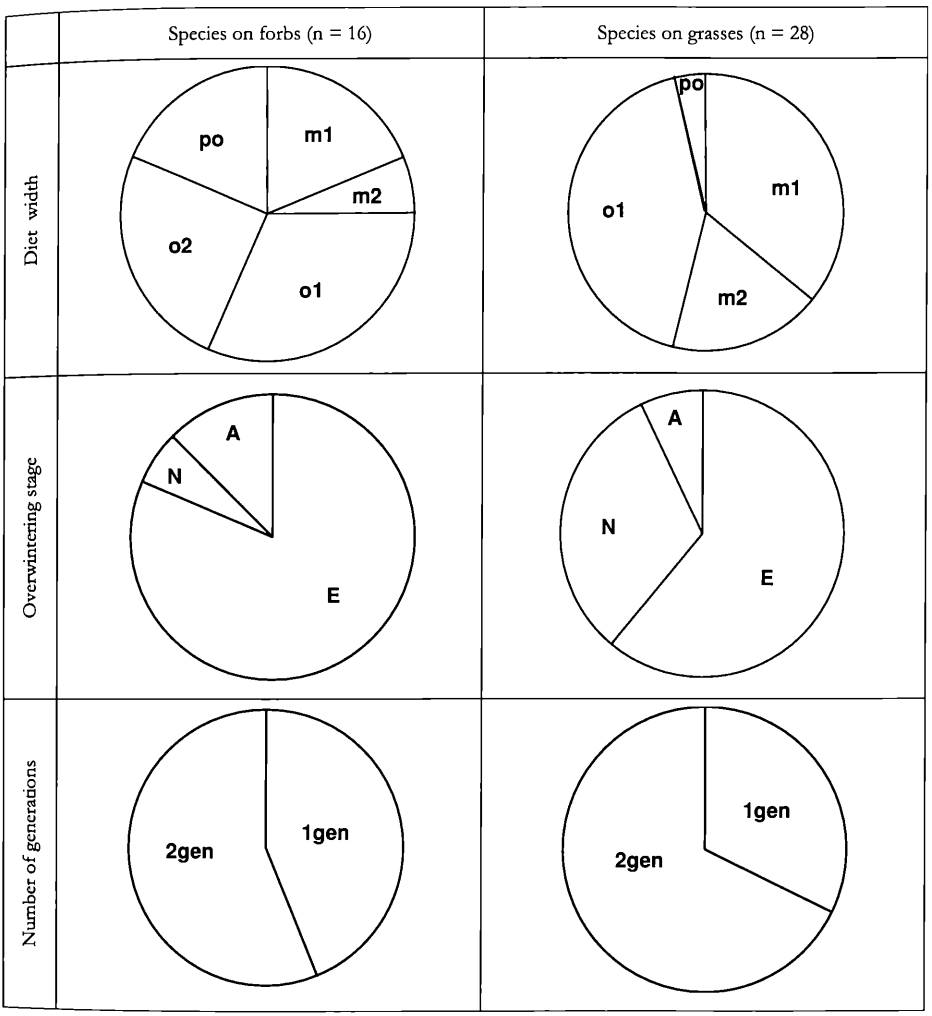

Fig. 2: The ratio of ecological parameters (diet width, overwintering stage and number of generations) in the groups of Auchenorrhyncha species living on forbs and grasses (after Nickel 2003). Diet width: m1 = 1st degree monophagous, 1 plant species, m2 = 2nd degree monophagous, 1 plant genus, o1 = 1st degree oligophagous, 1 plant family, o2 = 2nd degree oligophagous, 2 plant families or less than 5 species of less than 5 families, po = polyphagous; Overwintering stage: E = egg stage, N = nymphal stage, A = adult stage, 1gen = 1 generation per year, 2gen = 2 generations per year

Tab. 1: Auchenorrhyncha collected on forbs. Diet width: m1 = 1st degree monophagous, 1 plant species, m2 = 2nd degree monophagous, 1 plant genus, o1 = 1st degree oligophagous, 1 plant family, o2 = 2nd degree oligophagous, 2 plant families or less than 5 species of less than 5 families, po = polyphagous; Overwintering stage: E = egg stage, N = nymphal stage, A = adult stage (after Nickel 2003)

Species	*Hypericum perforatum*	*Trifolium arvense*	*Vincetoxicum hirundinaria*	*Galium mollugo*	*Verbascum lychnitis*	*Clinopodium vulgare*	*Salvia pratensis*	*Stachys recta*	*Thymus pulegioides*	*Thymus serpyllum*	*Artemisia campestris*	*Hieracium pilosella*	Overwintering stage	Diet width
Cercopis sanguinolenta (Scop.)				8									N	po
Megophthalmus scanicus (Fall.)		3											E	o1
Anaceratagallia ribauti (Oss.)		3											A	o2?
Aphrodes bicincta (Schrk.)		3											E	o1?
Planaphrodes trifasciata (Gfr.)										33			E	o2?
Erythria aureola (Fall.)									42				E	o2?
Emelyanoviana mollicula (Boh.)						84	60	3					E	po
Micantulina stigmatipennis (M. R.)					11								E?	m1?
Chlorita dumosa (Rib.)										26			E	m2
Chlorita paolii (Oss.)											61		E	o1
Eupteryx notata Curt.												25	E	o2
Eupteryx stachydearum (Hardy)							3						E	o1
Zygina hyperici (H.-S.)	88												E	m1
Neoaliturus fenestratus (H.-S.)												57	A	o1
Fieberiella septentrionalis W.Wg.			21										E	po
Laburrus impictifrons (Boh.)	.	.	.	.	.	.	.	.	.	.	13	.	E	m1
Total number of records	1	3	1	1	1	1	2	1	1	2	2	2		

Considering the investigated grasses, the constant association was recorded for 28 Auchenorrhyncha species (Tab. 2). The highest number of 10 species was recorded for the *Festuca ovina* species group. These included *Acanthodelphax spinosa*, *Kosswigianella exigua*, *Doratura stylata*, *Graphocraerus ventralis*, *Rhopalopyx preyssleri*, *Rhopalopyx vitripennis*, *Psammotettix confinis*, *Errastunus ocellaris*, *Turrutus socialis* and *Mocuellus collinus*. Only one species, respectively, revealed association with *Agrostis capillaris* (*Ribautodelphax collina*) and *Anthoxanthum odoratum* (*R. angulosa*).

The species caught in relatively high numbers (more than 50 individuals) were: *Megadelphax sordidula*, *Neophilaenus minor*, *Doratura stylata*, *Arocephalus languidus*, *Psammotettix excisus*, *Adarrus multinotatus*, *Turrutus socialis* and *Mocuellus collinus*.

The group of Auchenorrhyncha closely associated with grasses was characterized by a high ratio of monophagous species (54%) and forms hibernating as egg (61%) (Fig. 2).

Tab. 2: Auchenorrhyncha collected on grasses. Abbreviations see Tab. 1.

Species	*Agrostis capillaris*	*Anthoxanthum odoratum*	*Arrhenatherum elatius*	*Brachypodium pinnatum*	*Calamagrostis epigejos*	*Corynephorus canescens*	*Dactylis glomerata*	*Festuca ovina group*	*Phleum phleoides*	Overwintering stage	Diet width
Stenocranus major (Kbm			7	3	3					A	m1?
Eurybregma nigrolineata Scott							7			N	o1
Megadelphax sordidula (Stål)			79							N	m1?
Mirabella albifrons (Fieb.)					4					N	m2
Acanthodelphax spinosa (Fieb.)								8		N	m2
Kosswigianella exigua (Boh.)								21		N	m1
Javesella pellucida (F.)			31							N	po?
Ribautodelphax angulosa (Rib.)		16								N	m1
Ribautodelphax collina (Boh.)	43									N	m1
Ribautodelphax pungens (Rib.)				11						N	m1
Neophilaenus campestris (Fall.)							10			E	o1
Neophilaenus minor (Kbm.)						130				E	o1
Balclutha calamagrostis Oss.					45					A	m2
Doratura stylata (Boh.)								245		E	o1
Graphocraerus ventralis (Fall.)								14		E	o1
Rhopalopyx preyssleri (H.-S.)								17		E	m1
Rhopalopyx vitripennis (Fl.)								10		E	m2?
Cicadula persimilis (Edw.)							4			E	m1
Athysanus argentarius Metc.			15		5		3			E	o1
Arocephalus languidus (Fl.)									80	E	o1
Psammotettix alienus (Dhlb.)						20			3	E	o1
Psammotettix confinis (Dhlb.)						21		3		E	o1
Psammotettix excisus (Mats.)						164				E	m1?
Psammotettix poecilus (Fl.)					5					E	m2
Adarrus multinotatus (Boh.)				165						E	m1
Errastunus ocellaris (Fall.)					3			4		E	o1
Turrutus socialis (Fl.)			79					93		E	o1
Mocuellus collinus (Boh.)	.	.	11	.	.	.	.	39	.	E	o1
Total number of records	1	1	5	3	5	4	5	10	2		

At least two food plant records are given for the first time, notably *Phleum phleoides* for *Arocephalus languidus* and *Vincetoxicum hirundinaria* for *Fieberiella septentrionalis*, although the latter species is rather polyphagous. *Rhopalopyx preyssleri* (H.-S.) is in contrast to Nickel's (2003) results, who found this species monophagous on *Poa* (*pratensis*) *angustifolia*, an inconspicuous and low-growing grass of rather dry sites.

The following species are known only from a few localities in Poland:
Eurybregma nigrolineata Scott, 1875: Wielisław Złotoryjski near Złotoryja (Nast 1973); Olsztyn near Częstochowa, steppe-like vegetation (Świerczewski & Gębicki 2004); Krze-

mienica – N of Mielec, Karłów, Łężyckie Skałki nature reserve – N of Duszniki-Zdrój, Park Narodowy Gór Stołowych/Stołowe Mts. National Park (Gaj & Drożdż-Gaj 2005).
Ribautodelphax pungens (Ribaut, 1953): Wełecz near Busko-Zdrój; nature reserves with steppe-like vegetation: Grabowiec, Krzyżanowice, Skotniki Górne – S of Pińczów (Nast 1973); Młodzawy – S of Pińczów (Gębicki 1987).
Micantulina stigmatipennis (Mulsant et Rey, 1855): Bielinek – W of Chojna, steppe-like vegetation, collected from *Verbascum lychnitis* (Haupt 1931).
Chlorita dumosa (Ribaut, 1933): Kraków, sandy inland dune (Smreczyński 1954); steppe-like nature reserve Krzyżanowice near Pińczów (Nast 1955); Kampinoski Park Narodowy/Kampinoski National Park – NW of Warszawa, psammophilous grassland with *Koeleria pyramidata* (Schiemenz 1969); Puszcza Białowieska/Białowieska Primeval Forest – E of Hajnówka (Nast 1976).
Balclutha calamagrostis Ossiannilsson, 1961: Jaworzno – SE of Katowice, sand-pit excavation, psammophilous grassland (Szwedo 1996).

4. Discussion

The objectives of this study were to examine leafhopper preferences to forbs and grasses, which are notable constituents of the limestone and sandy grasslands on the Częstochowa Upland in Southern Poland. According to Nickel (2003), for the majority of central European Auchenorrhyncha the terms food plants (for feeding) and hosts (for ovipositing and nymphal development) can be used as synonyms. However, in this paper the term 'food plant' was chosen because nymphs were not identified. Another problem is small-scale migration of individuals. Therefore an insect-plant relationship was assumed only if there were at least three records on the particular plant.

More than half of the total species number of Auchenorrhyncha (27 out of 45) showed specifity to grasses (Poaceae). This phenomenon was described by Nickel (2002, 2003) as the graminoid paradoxon, meaning that although grasses and sedges constitute only about one eighth of the central European vascular flora, they provide a food source for almost half of the Auchenorrhyncha species. Further remarkable is that host specialists dominate although secondary compounds like alkaloids, terpenoids or phenolics are relatively rare in grasses.

The majority of grass-feeders in Germany are 1st degree monophagous or 1st degree oligophagous phloem feeders (Nickel 2003) (Fig. 3). Similar proportion was revealed considering trophic relationships of species collected from the investigated area with 36% of 1st degree monophagous, 18% of 2nd degree monophagous, 42% of 1st degree oligophagous and 4% of polygophagous. Fox & Morrow (1981) underline that specifity to particular plants is only a local or regional phenomenon in some studied taxa. In the investigated area *Arocephalus languidus* was collected only from *Phleum phleoides*, Baugnée (2003) in Belgium gives for this species *Sesleria caerulea*, in Germany it utilizes *Sesleria albicans*, *Stipa* spp. and probably also *Koeleria glauca* (Nickel 2003). The same can be argued for *Fieberiella septentrionalis* feeding on *Vincetoxicum hirundinaria* in the investigated area. The factors determining preference to particular grass species may involve: structural characteristics i.e. fine-leaved vs. coarse-leaved grasses (Morris 1990), nutritional value (Prestidge & McNeill 1983) and chemical barriers (Harbourne & Williams 1976). Moreover, the presence of other herbivores, predators or parasites should also be taken into consideration (Fox & Morrow 1981).

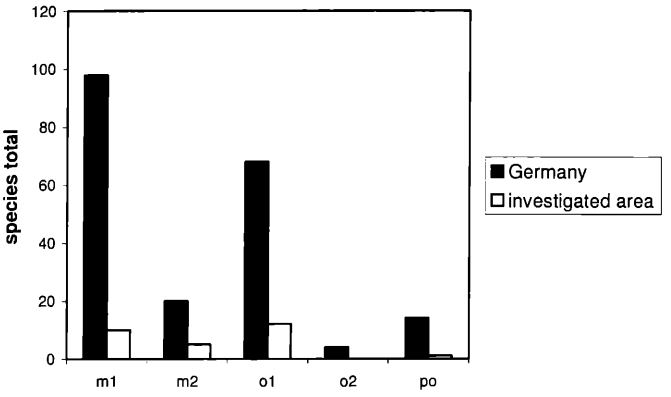

Fig. 3: Number of Auchenorrhyncha species regarding their diet width in Germany and investigated area of Poland. Abbreviations see Tab. 1.

The most diverse guild consisting of 10 species was found on *Festuca ovina*. In Germany this grass clearly holds the highest species number of any herbaceous plant, with 27 confirmed and 18 unconfirmed feeders, although some of them are apparently confined to grey-leaved subspecies (Nickel 2003). Guilds associated with *Arrhenatherum elatius*, *Calamagrostis epigejos* and *Dactylis glomerata* were less diverse (5 species, respectively). Tscharntke and Greiler (1995) showed that both shoot length and abundance of the grass species affect the species number of feeding insects. There are 5 to 12 times more species on grasses that are both abundant and tall than on grasses that are rare and small. Therefore feeding guilds of the tall and abundant grasses like *Arrhenatherum elatius*, *Calamagrostis epigejos* and *Dactylis glomerata* fit into the predicted pattern, but not *Festuca ovina*, because its shoot length is rather small.

Summarizing, this study gave first data on food preferences of 45 leafhoppers species associated with forbs and grasses from Poland. Regarding the whole number of 515 species known from this country it becomes clear that our knowledge of this subject is still unsatisfactory and that further investigations are needed. Such studies may reveal further geographic differences in insect-plant relationships.

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