Bull. Annls Soc. r. belge Ent. 132 (1996): *245-259*

Agromyzidae (Diptera) of the nature reserve "De Kuifeend": faunistics and life-history aspects*

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Abstract

During 1988, the agromyzid fauna of a lake border was studied in the nature reserve "De Kuifeend" (Oorderen, Belgium). The agromyzid flies were collected with a Malaise trap. At least fifty five species were captured during this study. Twenty four species turned out to be new for the Belgian fauna. Ecological aspects like phenology, sex ratio, host spectrum, and habitat specificity are discussed. A new diagnostic feature is mentioned for Agromyza bromi.

Samenvatting

Gedurende 1988 werden Agromyzidae verzameld in het natuurreservaat "De Kuifeend" (Oorderen, Belgium) met behulp van een Malaise val. Ten minste vijfenvijftig soorten Agromyzidae werden tijdens deze studie gevangen. Vierentwintig soorten worden voor de eerste maal gemeld voor België. Ecologische aspecten zoals fenologie, sex ratio, waardplantenspectrum en habitat selectie worden besproken. Een nieuw kenmerk van Agromyza bromi *wordt geïllustreerd.*

Introduction

Evaluations of conservation values of natural habitats are mostly based on surveys of larger invertebrates like birds and mammals and/or inventories of plants. Examples of invertebrates that are used as bio-indicators in

* Received: 1.XII.1995.
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these kind of studies are scarce and mostly limited to larger, more attractive groups of arthropods like Lepidoptera, Odonata, Coleoptera, Arachnida,... (e.g. USHER, 1973, 1990; MALFAIT *et al.*, 1989; SIEPEL, 1989; FRY & LONSDALE, 1991). Several authors (e.g. DISNEY, 1986; POLLET *et al.*, 1992a) pleaded for the use of Diptera in the assessment of conservation values. Advantages of Diptera are the large diversity within this group and the broad range of occupied ecological conditions. Some families of Diptera like Syrphidae (DE BRUYN *et al.*, 1992; HASLETT, 1991) and Dolichopodidae (POLLET & GROOTAERT, 1987; MEUFELS *et al.*, 1989; POLLET *et al.*, 1992a,b) have already proven their usefulness as bio-indicators.

However, little is known about distribution patterns, habitat specificity, and community structure within most groups of Diptera. Within the family of Agromyzidae, only recently, more attention has been paid to these aspects (VON TSCHIRNHAUS 1981, 1992, 1994; SCHEIRS *et al.*, 1995). Agromyzidae can be considered as potentially important bio-indicators because of the following advantages. They are for instance the family with the largest diversity within the Acalyptratae of the Paleaerctic Region (VON TSCHIRNHAUS, 1994). Secondly, all members of this family are phytophagous insects and live in close relation to their host plants with a close relation to their natural habitats as a consequence (VON TSCHIRNHAUS, 1994). However, we are still far from using Agromyzidae as bio-indicators because the necessary ecological and biological information is lacking for many species and habitats.

To collect ecological data about habitat specificity, distribution patterns, and community structure, the use of traps is advocated (e.g. SOUTHWOOD, 1978; KIRK, 1984). Malaise traps have been proven to be useful in these kind of studies. In this way, basic ecological information like phenology, voltinism and sex ratio can also be collected.

In the scope of a study of the habitat specificity of Agromyzidae, we investigated the agromyzid community of a lake border.

Material and methods

The study was conducted in the nature reserve "De Kuifeend", located in Oorderen (ES.98), Belgium. This reserve, a former polder that was partly inundated, consists of a lake surrounded by reed beds and wet meadows. In 1988, a Malaise trap (type TOWNES, 1972) was placed in an open spot in a reed bed near the border of the lake. A plant survey was made within a range of 50 m around the trap. The vegetation was dominated by *Phragmites australis* (CAV.) STEUD., *Urtica dioica* L., and *Anthriscus sylvestris* L. The complete list of plant species occurring at the trapping site is shown in Table 1. The trap was active throughout whole the year, except for two weeks from 17.VII. till 31.VII., and emptied at weekly intervals.

General identification keys for Agromyzidae were published by HENDEL (1931-1936), SPENCER (1972, 1976), and NOWAKOWSKI (1973). However, a reliable identification is only possibly when numerous additional publications are consulted.

Table 1. Vegetation occurring at trapping site (according to DE LANGHE *et al.* (1988)).

EQUISETACEAE
Equisetum arvense L.

URTICACEAE
Urtica dioica L.

CARYOPHYLLACEAE
Cerastium glomeratum THUILL.

POLYGONACEAE
Polygonum amphibium L.

SALICACEAE
Salix sp.

BRASSICACEAE
Rorippa amphibia (L.) BESSER

ONOGRACEAE
Epilobium hirsutum L.

RHAMNACEAE
Frangula alnus MILL.

APIACEAE
Anthriscus sylvestris L.
Heracleum sphondylium L.

SOLANACEAE
Solanum dulcamara L.

BORAGINACEAE
Myosotis cespitosa C.F. SCHULTZ
Symphytum officinale L.

LAMIACEAE
Glechoma hederacea L.
Lycopus europaeus L.
Mentha aquatica L.

RUBIACEAE
Galium aparine L.

CAPRIFOLIACEAE
Sambucus nigra L.

ASTERACEAE
Cirsium arvense (L.) SCOP.
Senecio erucifolius L.

ALISMATACEAE
Alisma plantago-aquatica L.

JUNCACEAE
Juncus effusus L.

CYPERACEAE
Carex spp.

POACEAE
Arrhenatherum elatius (L.) B. ex J. et C.P.
Elymus repens (L.) GOULD
Phragmites australis (CAV.) TRIN. ex ST.

TYPHACEAE
Typha latifolia L.

The identified Agromyzidae are stored in the collection of J. Scheirs at the University of Antwerp (RUCA). Later they will be deposited at the Royal Belgian Institute of Natural Sciences, Brussels.

Results and Discussion

Ecological, faunistical, and taxonomical remarks

During our sampling campaign, we captured 1471 specimens of Agromyzidae. We identified 55 species (Table 2). Several individuals (28♂ and 78♀) could not be identified because of the following reasons. Some species were still undescribed or their status was not clear, according to VON TSCHRINHAUS (pers. comm.) at least 200 undescribed agromyzid species occur in Europe. Other species could not be identified because only females were caught. The correct identification of females of Agromyzidae in the absence of males is only possible if one has a large reference collection (the first author lacks such a collection).

Twenty four species turned out to be new for the Belgian fauna (printed in bold and preceded by an * in Table 2). This brings the actual number of Agromyzidae present in the Belgian fauna up to approximately 152 species (many old records listed by De Bruyn & von Tschirnhaus (1991) must still be confirmed). In spite of the increasing number of faunistical studies of the Belgian agromyzid fauna (Scheirs *et al.*, 1993, 1994, 1995), this number is still very low compared to the number of species found in the surrounding countries (United Kingdom: 313, Spencer (1972); Netherlands: >150, Oosterbroek (1981); Germany: >320, Schumann (1992); France: >350, Martinez (pers. comm.)).

In the following survey, we consider species of faunistical, taxonomical or ecological interest. Ecological information, like phenology pattern and sex ratio, can be found in Table 2.

Agromyza anthracina: This species seems to be bivoltine. One generation was found from mid-April (24.IV) till mid-June (11.VI), a second generation was captured from 13.VIII till 8.X.

Agromyza bromi: Second report of this species in Belgium. *A. bromi* belongs to the *Agromyza ambigua*-group. All species of this group are Poaceae feeders with a shortened costa. This group contains many undescribed species, some of which were also present in the same trap. Species belonging to this group, especially female individuals, are difficult to identify because of the great number of undescribed species and the close resemblance between species within this group. When identifying *A. bromi*, two of us (J.S. & M.v.T) independently detected a new diagnostic feature. The males have a small, but striking, projection at the back of the trochanter of the first leg (Fig. 1). All 34 males of *A. bromi* in the von Tschirnhaus collection possess the same protuberance, sometimes equipped with more bristles than in Fig. 1. The males of the following 15 paleaerctic species of the *Agromyza ambigua*-group don't have such a projection (checked by von Tschirnhaus): *Agromyza ambigua* Fallén, *A. conjuncta* Spencer, *A. megalopsis* Hering, *A. mobilis* Meigen, *A. nigrella* (Rondani), *A. nigrociliata* Hendel, *A. rondensis* Strobl, and further 8 undescribed species in the von Tschinhaus collection.

Agromyza cinerascens: This is an univoltine species which occurs early in spring. We caught the species from 17.IV till 7.V This period of activity is confirmed by the results of von Tschirnhaus (1994), he mentions a flight period from April till May.

Agromyza graminicola: Individuals of this species were found in the traps from early May (7.V) till the end of September (24.IX). This is the second report of the species in Belgium, previously it was also found in Hoboken (Scheirs *et al.*, 1995).

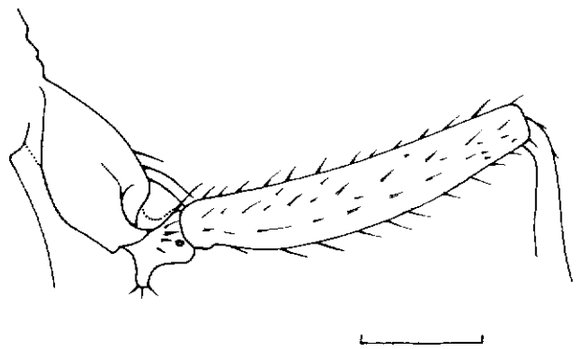

Fig. 1. Detail of the right leg of *Agromyza bromi* (drawing based on individual HP.226 from the collection of J. Scheirs). Scale line indicates 0.2 mm.

Agromyza hendeli: This species was captured from 14.V till 8.X *A. hendeli* seems to have a bivoltine flight period with peaks in the second half of June and around mid-August. Twice as many individuals were captured in August as in June.

Agromyza pseudoreptans: An univoltine species that was found late in the summer. It was caught from 31.VII till mid September (17.IX). Three individuals were trapped in autumn: 24-30.IX, 1♀; 8-15.X, 1♂; 29.X-5.XI, 1♀.

Agromyza reptans: This species was trapped from 24.IV till 10.IX. Peak numbers were reached during June. About 73% of the total number of individuals were caught in this month. von Tschirnhaus (1994) considers this species to be polyvoltine.

Aulagromyza anteposita: An univoltine species that occurs early in the year; it was caught in the trap from 3.IV till 7.V. von Tschirnhaus (1994) captured the species from 18.IV till 4.VII (his Malaise trap was only active from 18.IV), the largest proportion (86%) of these flies was however captured in the first two trapping weeks (18.IV till 2.V).

Cerodontha atra: Individuals of *C. atra* were captured from 30.IV till 17.IX with a small peak period from 31.VI till 13.VIII. According to Nowakowski (1973), this species can be found from May till August. Our data and those of Scheirs *et al.* (1995) prove that this species can be active at least until mid-September.

Cerodontha flavocingulata: This univoltine species occurred in late spring from 14.V till 25.VI. The following data confirm this flying period: von Tschirnhaus (1992), 2♂ and 1♀, 16-30.V; von Tschirnhaus (1994), 1♂, 6-20.VI; Scheirs *et al.* (1995), 1♂, 25.V-1.VI. Nowakowski (1973) has the same opinion; he mentions a flight period from April till the end of July.

Table 2. Phenological data and sex ratios of the species captured with the Malaise trap at "De Kuifeend". The phenological records are mentioned for each species on a two week basis. Species new to the Belgian fauna are printed in bold and preceded by an asterisk. In the last column the sex ratio is mentioned. Deviations from a 1♂:1♀ sex ratio were tested by a χ^2, goodness-of-fit test ($p<0.05$) when expected frequencies were larger or equal to 5, when smaller we used a binomial test (two-tailed, $P<0.05$)). Only the sex ratios of those species with more than 5 individuals captured in the trap were examined. Sex ratios that differ significantly from 1♂:1♀ are followed by ^{s}.

Nr.	Taxon	# Ind.	27. iii	10. iv	24. iv	07. v	21. v	04. vi	18. vi	03. vii	17. vii	31. vii	13. viii	27. viii	10. ix	24. ix	08. x	22. x	05. xi	19. xi	♂:♀
1.	*Agromyza albipennis* MEIGEN, 1830	13	.	.	.	.	1	.	2	2	6		1	.	.	1	.	.	.	.	9:4
* 2.	***Agromyza anthracina*** MEIGEN, 1830	45	.	.	.	10	7	12	2	.	.		.	4	7	2	1	.	.	.	33:12^{s}
3.	*Agromyza bromi* SPENCER, 1966	8	.	.	.	1	.	.	4	1	.		2	.	.	.	.	.	.	.	8:0^{s}
* 4.	***Agromyza cinerascens*** MACQUART, 1835	11	.	.	6	5	.	.	.	.	.		.	.	.	.	.	.	.	.	8:3
* 5.	***Agromyza ferruginosa*** V. D. WULP, 1871	2	.	.	.	.	.	.	.	2	.		.	.	.	.	.	.	.	.	2:0
6.	*Agromyza graminicola* HENDEL, 1931	35	.	.	.	.	1	1	1	7	9		6	6	3	1	.	.	.	.	23:12
7.	*Agromyza hendeli* GRIFFITHS, 1963	238	.	.	.	.	4	10	37	33	7		61	62	22	1	1	.	.	.	204:34^{s}
* 8.	***Agromyza mobilis*** MEIGEN, 1830	15	.	.	.	.	1	2	3	2	1		1	4	.	.	1	.	.	.	13:2^{s}
* 9.	***Agromyza myosotidis*** KALTENBACH, 1864	1	.	.	.	.	.	1	.	.	.		.	.	.	.	.	.	.	.	1:0
* 10.	***Agromyza nana*** MEIGEN, 1830	1	.	.	.	.	.	.	.	.	.		.	.	1	.	.	.	.	.	0:1
11.	*Agromyza nigripes* MEIGEN, 1830	23	.	.	.	1	.	.	.	8	2		11	.	.	1	.	.	.	.	16:7
12.	*Agromyza phragmitidis* HENDEL, 1922	2	.	.	.	.	.	.	.	1	.		.	1	.	.	.	.	.	.	1:1
* 13.	***Agromyza pseudoreptans*** NOWAK., 1967	80	.	.	.	.	.	.	.	.	.		39	29	8	1	1	1	1	.	15:65^{s}
14.	*Agromyza reptans* FALLÉN, 1823	181	.	.	.	4	2	19	53	65	18		13	5	2	.	.	.	.	.	135:46^{s}
* 15.	***Amauromyza chenopodivora*** SP., 1971	4	.	.	.	.	.	.	3	1	.		.	.	.	.	.	.	.	.	2:2
16.	*Amauromyza flavifrons* (MEIGEN, 1830)	1	.	.	.	.	.	.	.	.	.		.	.	.	1	.	.	.	.	1:0
* 17.	***Amauromyza luteiceps*** (HENDEL, 1920)	1	.	.	.	.	.	.	.	.	.		1	.	.	.	.	.	.	.	1:0
* 18.	***Aulagromyza anteposita*** (STROBL, 1898)	33	.	2	22	9	.	.	.	.	.		.	.	.	.	.	.	.	.	18:15
* 19.	***Aulagromyza discrepans*** (WULP, 1871)	4	.	.	.	.	1	2	.	1	.		.	.	.	.	.	.	.	.	1:3
20.	*Cerodontha angulata* (LOEW, 1869)	8	.	.	.	.	.	.	.	.	.		5	2	1	.	.	.	.	.	4:4
21.	*Cerodontha atra* (MEIGEN, 1830)	32	.	.	.	1	.	3	2	1	5		13	3	2	2	.	.	.	.	29:3^{s}
22.	*Cerodontha denticornis* (PANZER, 1806)	6	.	.	.	.	.	1	1	1	.		1	1	.	.	1	.	.	.	0:6^{s}
23.	*Cerodontha fasciata* (STROBL, 1880)	5	.	.	.	.	.	.	1	1	1		2	.	.	.	.	.	.	.	3:2
24.	*Cerodontha flavocingulata* (STROBL, 1909)	22	.	.	.	.	2	15	4	1	.		.	.	.	.	.	.	.	.	19:3^{s}
25.	*Cerodontha incisa* (MEIGEN, 1830)	4	.	.	.	.	.	.	.	.	2		2	.	.	.	.	.	.	.	1:3
* 26.	***Cerodontha lateralis*** (MACQUART, 1835)	9	.	.	.	1	1	.	.	4	2		.	.	1	.	.	.	.	.	6:3
27.	*Cerodontha luctuosa* (MEIGEN, 1830)	18	.	.	.	.	.	1	1	.	.		7	6	3	.	.	.	.	.	14:4^{s}
28.	*Cerodontha phragmitidis* NOW., 1967	18	.	.	.	.	1	6	1	1	1		4	4	.	.	.	.	.	.	9:9
* 29.	***Cerodontha phragmitophila*** (HER., 1935)	1	.	.	.	.	.	.	.	.	.		1	.	.	.	.	.	.	.	0:1
30.	*Cerodontha pygmaea* (MEIGEN, 1830)	1	.	.	.	.	.	.	.	.	1		.	.	.	.	.	.	.	.	1:0
* 31.	***Cerodontha suturalis*** (HENDEL, 1931)	1	.	.	.	.	.	.	.	.	.		1	.	.	.	.	.	.	.	0:1

Nr.	Taxon	# Ind.	27. iii	10. iv	24. iv	07. v	21. v	04. vi	18. vi	03. vii	17. vii	31. vii	13. viii	27. viii	10. ix	24. ix	08. x	22. x	05. xi	19. xi	♂:♀
32.	*Chromatomyia milii* (KALTENBACH, 1864)	100	.	.	6	9	3	31	3	17	27		2	.	.	.	1	.	.	1	58:42
33.	*Chromatomyia nigra* (MEIGEN, 1830)	35	.	4	4	3	1	11	4	1	3		4	.	.	.	.	.	.	.	11:24[S]
34.	*Liriomyza flaveola* (FALLÉN, 1823)	3	.	.	.	.	1	1	.	1	.		.	.	.	.	.	.	.	.	2:1
* 35.	***Liriomyza infuscata*** HERING, 1926	1	.	.	.	.	.	.	.	.	.		.	.	.	.	.	1	.	.	0:1
36.	*Liriomyza phryne* HENDEL, 1931	7	.	.	.	1	1	1	.	.	3		.	1	.	.	.	.	.	.	2:5
* 37.	***Melanagromyza aenea*** (MEIGEN, 1830)	22	.	.	.	1	6	10	1	1	.		2	1	.	.	.	.	.	.	9:13
38.	*Melanagromyza aeneoventris* (FALL., 1823)	44	.	.	.	.	2	8	13	5	1		7	7	1	.	.	.	.	.	19:25
* 39.	***Melanagromyza limata*** SPENCER, 1971	101	.	.	.	.	6	17	30	25	6		12	4	1	.	.	.	.	.	78:23[S]
* 40.	***Melanagromyza pubescens*** HENDEL, 1923	2	.	.	.	.	.	.	1	.	1		.	.	.	.	.	.	.	.	1:1
* 41.	***Melanagromyza symphyti*** GRIFFITHS, 1963	12	.	.	.	.	.	2	.	3	3		4	.	.	.	.	.	.	.	9:3
42.	*Metopomyza flavonotata* (HALIDAY, 1831)	1	.	.	.	.	.	.	1	.	.		.	.	.	.	.	.	.	.	1:0
* 43.	***Napomyza carotae*** SPENCER, 1966	106	.	.	.	31	28	6	.	2	19		14	4	1	1	.	.	.	.	75:31[S]
44.	*Ophiomyia pulicaria* (MEIGEN, 1830)	1	.	.	.	.	.	.	.	.	.		1	.	.	.	.	.	.	.	1:0
* 45.	***Ophiomyia skanensis*** SPENCER, 1976	1	.	.	.	.	.	.	.	.	.		1	.	.	.	.	.	.	.	1:0
46.	*Phytomyza chaerophylli* KALTENB., 1856	31	.	.	2	8	.	8	8	4	.		.	1	.	.	.	.	.	.	25:6[S]
47.	*Phytomyza cirsii* HENDEL, 1923	20	.	.	.	.	.	4	4	.	2		8	1	.	1	.	.	.	.	15:5[S]
* 48.	***Phytomyza continua*** HENDEL, 1920	16	.	.	.	3	.	4	2	1	3		3	.	.	.	.	.	.	.	8:8
49.	*Phytomyza flavicornis* FALLÉN, 1823	6	.	.	.	6	.	.	.	.	.		.	.	.	.	.	.	.	.	1:5
50.	*Phytomyza glechomae* KALTENBACH, 1862	1	.	.	1	.	.	.	.	.	.		.	.	.	.	.	.	.	.	1:0
* 51.	***Phytomyza pastinacae*** HENDEL, 1923	2	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	2:0
52.	*Phytomyza ranunculi* (SCHRANK, 1803)	21	.	.	3	7	5	.	2	.	.		.	.	.	.	1	3	.	2	10:11
53.	*Phytomyza rufipes* MEIGEN, 1830	1	.	.	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	0:1
54.	*Phytomyza spinaciae* HENDEL, 1928	6	.	.	.	.	.	.	.	.	.		1	.	.	.	.	.	.	.	3:3
* 55.	***Phytomyza symphyti*** HENDEL, 1935	2	.	.	.	.	.	.	1	2	3		.	.	.	.	.	.	.	.	3:3
								.	.	.	1		1	.	.	.	.	.	.	.	2:0

Cerodontha luctuosa: Two individuals were captured in June, most individuals were however captured in August from 31.VII till 20.VIII. Three individuals were captured from 3.IX till 10.IX. NOWAKOWSKI (1973) believes that *C. luctuosa* occurs in 2 to 3 generations and mentions a flight period from April till October (November is mentioned between brackets).

Cerodontha phragmitidis: Specimens were found from 14.V till 27.VIII. Two main periods of activity occurred: around the end of May and the beginning of June, and in August. This species seems to be bivoltine like other *Phragmites* miners; *Agromyza hendeli* and *A. phragmitidis*. NOWAKOWSKI (1973) mentions the existence of two generations and a flight period from April till September.

Chromatomyia milii: A long period of activity ! Captured from 10.IV till 6.VIII and two individuals captured in autumn: 1♂ between 30.IX and 8.X, and 1♀ between 5 and 12.XI.

Chromatomyia nigra: This species was captured the earliest in the season, from 27.III till 6.VIII.

Melanagromyza aenea: Individuals were captured from 30.IV till 25.VI and, later on, three females were captured in August during the period from 31.VII till 27.VIII. In VON TSCHIRNHAUS (1992), we find the following pattern. Most individuals (2♂ and 10♀) were captured in May (from 16-30.V), then none were captured for 3 weeks, and from 20.VI till 8.VIII only females (N=7) were captured. *M. aenea* seems to have 2 generations. In both studies, the first generation occurred around May. The data of the two studies don't agree however on the occurrence of the second generation. During the last generation, in both studies, females outnumbered the males in the trap.

Melanagromyza aeneoventris: This species seems to have a long period of activity, it was captured from 14.V till 3.IX. In VON TSCHIRNHAUS (1992) we find a comparable flying period: from 16.V till 22.VIII.

Melanagromyza limata: The species was captured from 14.V till 3.IX, a flight period comparable with *M. aeneoventris*. Most individuals were captured in June. VON TSCHIRNHAUS (1994) observed a shorter flight period for *M. limata*, from the end of May (23.V) till the beginning of July

(4.VII). He therefore concluded that this species must be univoltine. According to our results, this species seem to be bivoltine. Peak numbers occurred in early summer and a small revival of abundance could be noted in August.

This species has been previously recorded only in Britain (North and South Wales) (SPENCER, 1971, 1990) and Germany (Ahr-Eifel) (VON TSCHIRNHAUS, 1994).

Melanagromyza symphyti: Little is known about the distribution of this species. Previously, it was only recorded in England, USSR, Germany (VON TSCHRINHAUS, 1992), and Lithuania (PAKALNIŠKIS, 1993).

Napomyza carotae: This species belongs to the *N. lateralis*-group, a group of species which are very difficult to separate. SPENCER (1966) described this species, distinguishing it from *N. lateralis* by the different costal ratio and the presence of a distinct short fringe on the third antennal segment of *N. carotae*. Further diagnostic characters for *N. carotae* are the thickened palps of the ♂♂, and the typical hypophallus and hypandrium.

WIESMANN (1961) made a study of the phenology pattern of this species (as *N. lateralis*). He found the existance of two well defined generations. Emergence of the first generation started from the beginning of May till the first week of June; this generation peaked in the latter half of May. The second generation occurred from the first half of August till the end of September, with a peak around the end of August. He pointed out the existence of a partial third generation: some flies emerged in the beginning of October.

Our results confirm the existence of two generations. A first generation occurred around May, individuals of this generation were captured from 24.IV till 4.VI and densities peaked from 30.IV till 14.V. Specimens of the second generation were caught from 18.VI till 27.VIII, it was impossible to establish the peak in this generation because of the interrupted trapping sequence. Two male individuals were trapped rather late in the season: one from 3-10.IX and the other ♂ in the next trapping week (10-17.IX).

Four additional individuals (2♂+2♀) of this species were swept on 2.V. 1994 from a plot of *Anthriscus sylvestris* L. occurring at the sampling site.

Ophiomyia skanensis: Previously, only known from Sweden, Lithuania, and Germany (VON TSCHIRNHAUS, 1992).

Phytomyza chaerophylli: We captured this species from 10.IV till 3.VII. One ♂ individual was trapped later in the season, between 13 and 20.VIII.

Phytomyza flavicornis: An univoltine species occurring early in spring. *P. flavicornis* was caught from 24.IV till 7.V. This early flight period is explained by VON TSCHRINHAUS (1994) by the fact that the females can only lay their eggs in young stems of *Urtica*.

Phytomyza ranunculi: This species was caught early in spring from 10.IV till 21.V and in autumn from 30.IX till 19.XI. Results of VON TSCHIRNHAUS (1992) mention a comparable flying period.

One male individual was swept from the vegetation occurring in the trapping site on 2.V.1994.

Sex ratio

The sex ratio observed in Malaise traps is not necessarily the sex ratio occurring in the field because sexes may respond differently to the trapping method used. Investigation of the sex ratio of the agromyzid species captured in different Malaise traps pointed out that, in most cases, the sex ratio is in favour of the females (see SCHEIRS *et al.*, in prep.). However, in the Malaise trap of this study exceptionally many sex ratios deviated in favour of the males. In 12 species, significantly more males than females were trapped. Only in three species did females significantly outnumber the males. Also the sex ratio of the total number of trapped individuals (939♂:532♀) deviated significantly ($\chi^2=113.24$, df=1, $p<0.0001$) in favour of the males. We have no explanation for the observed phenomenon.

Habitat preference

Dealing with phytophagous insects, one can assume that the species composition of a site must be related to some extent to the plant community present at that site. We investigated this relationship for the Agromyzidae we captured in this study. All species with known hosts are listed in Table 3 together with their respective host plants.

Looking at the (more or less) monophagous species in this list we see that there are for instance five species that mine *Urtica*, viz. *Agromyza anthracina, A. reptans, A. pseudoreptans, Melanagromyza aenea,* and *Phytomyza flavicornis*. Another large group (N=5) are the species that mine *Phragmites*, viz. *Agromyza graminicola, A. hendeli, A. phragmitidis, Cerodontha phragmitidis,* and *C. phragmitophila*. Other groups are the miners of *Symphytum* (at least 3), *Galium* (probably 2), *Cirsium* (probably 4), and *Carex* (2). Monophagous leaf miners of *Chenopodium, Atriplex, Juncus, Heracleum, Bromus, Poa*, and *Glechoma* were each represented by a single species. The other captured species are all to some extent oligophagous, so we were unable to reveal their local host. A large proportion of the captured species (41%) lives on members of the Poaceae.

When we compare the hosts of the monophagous species with the vegetation occurring at that site (Table 1 versus 3) we see that there is a great resemblance. Miners of *Phragmites australis* and *Urtica dioica*, two dominating plant species at the trapping site, are well represented as well in regard to the number of species as the number of individuals captured. Miners of the third dominating plant species, *Anthriscus sylvestris*, were also present. *Phytomyza chaerophylli* and *Napomyza carotae* are two miners of Apiaceae which were caught in considerable numbers. The hosts of the other monophagous miners were present at the trapping site except the hosts of *Amauromyza chenopodivora (Chenopodium), Amauromyza luteiceps (Atriplex), Cerodontha fasciata (Poa),* and *Agromyza bromi (Bromus)*. These latter species were all present only in small numbers (see Table 2).

Table 3. Agromyzid species together with their respective hosts. Only the host genera of monophagous or nearly monophagous species are mentioned. Host records are listed according to SPENCER (1990) and VON TSCHIRNHAUS (1992, 1994).

Plant family	Agromyzid species	Plant genera
Ranunculaceae	*Phytomyza ranunculi*	*Ranunculus, Ficaria, Myosurus*
Urticaceae	*Agromyza anthracina*	*Urtica, Parietaria*
	Agromyza reptans	*Urtica*
	Agromyza pseudoreptans	*Urtica, Laportea, Parietaria*
	Melanagromyza aenea	*Urtica*
	Phytomyza flavicornis	*Urtica*
Caryophyllaceae	*Amauromyza flavifrons*	also on Chenopodiaceae
Chenopodiaceae	*Amauromyza chenopodivora*	*Chenopodium*
	Amauromyza flavifrons	
	Amauromyza luteiceps	*Atriplex*
Brassicaceae	*Phytomyza rufipes*	
Fabaceae	*Agromyza nana*	
Apiaceae	*Melanagromyza limata*	*Heracleum*
	Napomyza carotae	*Daucus, Anthriscus*
	Phytomyza chaerophylli	
Boraginaceae	*Agromyza ferruginosa*	*Symphytum, Pulmonaria*
	Agromyza myosotidis	
	Melanagromyza symphyti	*Symphytum*
	Phytomyza symphyti	*Symphytum, Echium*
Lamiaceae	*Phytomyza glechomae*	*Glechoma*
Rubiaceae	*Aulagromyza anteposita*	*Galium*
	Aulagromyza discrepans	(probably *Galium*)
Asteraceae	*Melanagromyza aeneoventris*	*Cirsium, Carduus, Inula*
	Phytomyza cirsii	*Cirsium, Cynara, Serratula*
	Phytomyza continua	*Cirsium, Carduus*
	Phytomyza spinaciae	*Cirsium, Cnicus, Carduus, Onopordum, Serratula*
	Ophiomyia pulicaria	
Juncaceae	*Cerodontha luctuosa*	*Juncus*
Cyperaceae	*Cerodontha angulata*	*Carex, Scirpus*
	Cerodontha suturalis	*Carex*
Poaceae	*Agromyza albipennis*	
	Agromyza bromi	*Bromus*
	Agromyza cinerascens	
	Agromyza graminicola	*Phragmites*
	Agromyza hendeli	*Phragmites*
	Agromyza nigripes	
	Agromyza phragmitidis	*Phragmites*
	Cerodontha atra	
	Cerodontha denticornis	
	Cerodontha fasciata	*Poa*
	Cerodontha flavocingulata	
	Cerodontha incisa	
	Cerodontha lateralis	
	Cerodontha phragmitidis	*Phragmites*
	Cerodontha phragmitophila	*Phragmites, Arundo*
	Cerodontha pygmaea	
	Chromatomyia milii	
	Chromatomyia nigra	
	Liriomyza flaveola	
	Liriomyza phryne	

We can conclude that the agromyzid fauna at this study site stands in close relation to the vegetation occurring at that site. A close relationship between the Agromyzidae and their natural habitat has already been mentioned by VON TSCHIRNHAUS (1994). Because of this behaviour, Agromyzidae are probably very useful bio-indicators. Further studies however are needed to collect information about the agromyzid fauna of different plant associations, before Agromyzidae can be used as bio-indicators. Dune islands, a river bank, and an older forest are already under study by VON TSCHIRNHAUS.

Acknowledgments

We thank Arlette LEMOUCHE for emptying the Malaise trap and the identification and characterization of the vegetation, Ludo BENOY for the permission to collect insects in the nature reserve "De Kuifeend", and Rika VAN TICHELEN for the drawings.

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