

## New records of scuttle flies (Diptera: Phoridae) from Iceland, with a survey of all simultaneously collected Dipteran families

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During a visit to Iceland in 2001, 727 specimens of Phoridae were caught. Seven species of Phoridae were identified, five of which were recorded from Iceland for the first time: *Megaselia coccyx* Schmitz, 1965; *M. humeralis* (Zetterstedt, 1838); *M. parnassia* Disney, 1986; *M. quadriseta* (Schmitz, 1941) and *M. tarsicia* Schmitz, 1926. The most abundant and most widespread phorid fly of the study was *Megaselia coccyx*, of which 510 specimens (70% of the catch) on 18 of 29 sampling sites were caught. The female of *Triphleba renidens* Schmitz, 1927 is given an improved diagnosis, and the abdominal sternite 7 is illustrated for the first time. With the results of this study a total of 11 species of Phoridae have been identified from Iceland. Four of them were also recorded from Greenland and 3 from the Faroe Islands. An overview of all other 36 families of Diptera (more than 48,394 specimens) obtained during the same excursion to Iceland is also presented.

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### 1. Introduction

The Phoridae fauna of Iceland can be considered as being poorly known: a checklist of the fauna of this country lists only six species (Ólafsson 1991). Potentially many other Phoridae species can develop in the extreme conditions, although e.g. the capital Reykjavik has an average annual temperature of only +5.1°C. M. von Tschirnhaus, together with students of biology of the University of Bielefeld, Germany, carried out an excursion to Iceland in 2001, during which large numbers of insects were collected. This material, after

having been sorted to family level, has been made available for scientific study. First results of the Diptera have been published by Kassebeer (2002) and of the Hymenoptera by Buhl (2002). In this paper, we present the extensive phorid material in detail.

### 2. Material and methods

A map showing the sampling sites is shown in Fig. 1. Table 1 gives details of the sites where Phoridae were caught. Altogether 30 and 5



Table 1. List of sampling sites of Phoridae with information about the location, landscape and vegetation; positions are marked on map (Fig. 1).

Longitude/ Latitude	Nr. in the map	Date of sampling	Location	Landscape and dominant vegetation
65°16'N 14°25'W	1412	22.VI.01	Egilsstaðir	Grassland
65°56'N 16°33'W	1413	24–25.VI.01	Jökulsárgljúfur National Park	Diverse herbaceous vegetation with <i>Taraxacum</i> , <i>Juncus</i> , <i>Geranium</i>
64°30'N 21°55'W	1415	11.VII.01	Eastern coast of Borgarfjörður	<i>Betula</i> forest and mountain grassland
63°57'N 22°39'W	1417	16.VII.01	Western coast of Reykjanes peninsula	Salt marsh with <i>Plantago maritima</i> , <i>Angelica archangelica</i> , <i>Carex</i>
63°51'N 22°43'W	1418	16.VII.01	Western coast of Reykjanes peninsula	Brackish lake within dunes with <i>Rhinanthus minor</i> , <i>Parnassia palustris</i> , <i>Ranunculus acer</i>
63°52'N 19°13'W	1420	22.VII.01	Central Iceland	Valley with <i>Carex</i> , <i>Taraxacum</i> , <i>Equisetum</i>
64°24'N 20°03'W	1422	23.VII.01	Central Iceland	Gravel plain with scattered vegetation, mainly <i>Deschampsia beringensis</i> and <i>Festuca rubra</i>
65°54'N 18°05'W	1425	26.VII.01	Delta of river Frijoská	Fresh water marsh with <i>Vicia</i> , <i>Euphrasia hirtella</i> , <i>Rhinanthus minor</i> , <i>Trifolium repens</i>
65°53'N 18°03'W	1426	26.VII.01	Mountain slopes of the Stórhnjúkur	<i>Betula pubescens</i> forest with <i>Empetrum nigrum</i> , <i>Vaccinium myrtillus</i> , <i>Pinguicula vulgaris</i>
65°57'N 18°10'W	1427	27.VII.01	Coast of Eyafjörður fjord	Urban plot with swamp vegetation: <i>Hippuris vulgaris</i> , <i>Carex magellanicus</i> , <i>Eriophorum scheuchzeri</i>
65°38'N 16°55'W	1428	28.VII.01	North eastern part of lake Mývatn	Shore with <i>Carex</i> , <i>Caltha palustris</i> , <i>Salix</i> , <i>Rumex</i> , <i>Galium</i>
66°12'N 16°28'W	1431	31.VII.01	Eastern shore of the mouth of river Sandá	Roadside along a lake. Mainly <i>Eleocharis</i> on gravel ground
66°23'N 16°31'W	1432	1.VIII.01	Atlantic coast	Mainly heather and grassland with adjoining stony beach
65°59'N 17°31'W	1433	2.VIII.01	South of the dune girdle along the Atlantic coast	Sandy ground with <i>Leymus arenarius</i> , <i>Juncus</i> , <i>Euphrasia</i> , <i>Ranunculus repens</i> , <i>Rhinanthus minor</i>
65°58'N 18°59'W	1434	3–4.VIII.01	Western slopes above the lake Stifluvatn	Wet slopes with diverse vegetation: Poaceae, mosses, <i>Alchemilla alpina</i> , <i>Empetrum nigrum</i> , <i>Thymus praecox</i>
65°59'N 19°24'W	1435	4.VIII.01	Eastern coast of Skagafjörður	Sown young grass on flattened ground along a viewpoint with <i>Phleum pratense</i>
64°59'N 23°14'W	1436	6.VIII.01	Northern coast of Snæfjallnes peninsula	Beach flora and meadows with Poaceae, <i>Ranunculus acer</i> , <i>Carex</i> , <i>Leontodon autumnalis</i> , <i>Rumex</i> , <i>comarum palustre</i> , <i>Bistorta vivipara</i> ; bird excrements by a colony of terns ( <i>Sterna</i> )
65°04'N 22°44'W	1438	6.VIII.01	Northern part of Snæfjallnes peninsula	Herbaceous vegetation with <i>Eriophorum angustifolium</i> , <i>Ranunculus acer</i> , <i>Equisetum</i> , <i>Leontodon autumnalis</i>
65°02'N 22°33'W	1439	6.VIII.01	Northern part of Snæfjallnes peninsula	Wet grassland and ditches with <i>Equisetum arvense</i> , <i>Alchemilla alpina</i> , <i>Ranunculus acer</i>
64°51'N 22°20'W	1443	9.VIII.01	Eastern part of Snæfjallnes peninsula	Muddy swamp with <i>Eleocharis</i> , <i>Carex</i> , <i>Ranunculus repens</i> , Poaceae
64°50'N 23°15'W	1444	9.VIII.01	Southern part of Snæfjallnes peninsula	Lake shore with diverse vegetation: <i>Carex</i> , <i>Luzula</i> , <i>Festuca vivipara</i> , <i>Leontodon autumnalis</i> , <i>Filipendula ulmaria</i>
64°38'N 22°23'W	1445	10.VIII.01	Atlantic coast	Diverse salt water influenced vegetation with <i>Vicia</i> , <i>Plantago maritima</i> , <i>Euphrasia</i> , <i>Rhinanthus minor</i>
65°32'N 23°13'W	1446	2.IX.01	Southern coast of Barðaströnd peninsula	Heather along a footpath to an area with fossils

Table 2. List of Diptera families and numbers of specimen caught in the study (Chironomidae were not completely counted). Nematocera = family of Nematocera; Brachycera = family of Brachycera.

Nematocera	Nr. individuals	Brachycera	Nr. individuals
Bibionidae	111	Anthomyiidae, Muscidae	6,571
Cecidomyiidae	119	Agromyzidae	1,224
Ceratopogonidae	66	Anthomyzidae	167
Chironomidae	>24,403	Carnidae	4
Mycetophilidae	205	Chamaemyiidae	31
Psychodidae	13	Chloropidae	484
Simuliidae	1,035	Coelopidae	2,370
Tipulidae, Limoniidae	450	Dolichopodidae	1,785
Scatopsidae	22	Drosophilidae	336
Sciaridae	673	Empididae, Hybotidae	788
		Ephydriidae	2,969
		Helcomyzidae	438
		Heleomyzidae	41
		Lonchopteridae	65
		Pallopteridae	11
		Phoridae	727
		Piophilidae	35
		Psilidae	174
		Scatophagidae	1,283
		Sciomyzidae	16
		Sepsidae	754
		Sphaeroceridae	719
		Syrphidae	305
Total	>27,097	Total	21,297

to 11 (Table 4). The number of Phoridae on Iceland, the Faroe Islands and Greenland altogether now totals 18 (Table 4). *Megaselia coccyx* Schmitz, 1965 was the most abundant phorid in our study and accounted for about 70% of the total catch; *M. pleuralis* (Wood, 1909) was also abundant, found on five sites with a total of 100 specimens (14% of the catch); *M. tarsicia* Schmitz, 1926 formed 1.7% of the total catch (Table 3). The *Megaselia* females were not identified, as the only available determination key does not include females (Disney 1989), and the material did not allow a reliable association.

#### 4. Discussion

*Megaselia coccyx*, the most abundant phorid in our samples, has striking morphological features such as a strongly inflated postero-dorsal region of the upper part of the hypopygium and a broad tarsal segment 5. It has been found in the northern parts of Europe, e.g. from Scotland, Finland and

Sweden (Schmitz *et al.* 1938–1981; Weber & Prescher 2004), but also in a laurel forest on Tenerife (Disney 1990). This is the first record for Iceland. *M. coccyx* was caught on 18 out of 29 sampling sites (Table 3), which makes it the most widely distributed species of Phoridae on Iceland. *Megaselia coccyx* occurred on all sampling sites on the Snæfellsnes Peninsula (sites 1436–1444) that is situated around the Snæfellsjökull glacier in western Iceland. This species was also the most abundant at three sampling sites on the northern coast of the Snæfellsness Peninsula. One site (1438) had diverse flowering dicotyledoneous vegetation. Other sampling sites (1436 and 1442) also had many flowering plants and additional bird excrement deposited by a colony of terns. However, nothing is known about the development and nutritional habits of the larvae of *M. coccyx*.

*Megaselia pleuralis*, another abundant phorid, is widely distributed in Europe, including sites in the Alps 2,000 m above sea level (Schmitz *et al.* 1938–1981). The same authors have re-

Table 3. Species list of the study sites on Iceland. For the position of the sampling sites, see Fig. 1.  
*M.* = *Megaselia*, *T.* = *Triphleba*.

Site nr.	<i>M. coccyx</i>	<i>M. humeralis</i>	<i>M. parnassia</i>	<i>M. pleuralis</i>	<i>M. quadriseta</i>	<i>M. tarsicia</i>	<i>M. females</i>	<i>T. renidens</i>	Total
1412	–	–	1	–	–	–	–	7	8
1413	–	–	–	–	–	–	1	–	1
1415	7	–	–	–	–	–	–	5	12
1417	–	–	–	4	–	–	–	–	4
1418	3	–	–	–	–	–	1	–	4
1420	–	1	–	–	–	1	–	2	4
1422	33	–	–	–	–	–	2	–	35
1425	2	–	–	1	–	–	2	–	5
1426	6	–	–	–	–	–	1	–	7
1427	1	–	–	–	–	–	1	2	4
1428	–	–	–	–	–	–	5	–	5
1431	2	–	–	–	–	–	1	–	3
1432	20	–	1	72	–	4	13	1	111
1433	11	–	–	–	–	1	–	–	12
1434	2	–	–	–	–	1	5	1	9
1435	7	–	–	–	–	–	–	–	7
1436	44	–	–	15	–	1	5	–	65
1438	285	–	1	–	–	5	28	–	319
1439	5	–	–	–	2	–	5	–	12
1442	66	–	–	8	–	–	5	–	79
1443	2	1	–	–	–	–	2	–	5
1444	13	–	–	–	1	–	2	–	16
1445	–	–	–	–	–	–	1	–	1
1446	1	–	–	–	–	–	–	–	1
Total	510	2	3	100	3	13	80	18	729

corded *M. pleuralis* also from Iceland and Greenland. Many individuals were caught on a site in northern Iceland at the Atlantic coast, among heather and grass vegetation (1432). The larvae of *M. pleuralis* are known to have developed in pigeon dung (Disney 1994), in a compost heap (Werner 1997) and in dead spruce wood (B. Wermelinger, pers. comm.). These findings suggest a polysaprophagous diet of the larvae.

*Megaselia tarsicia* Schmitz, 1926 has striking features similar to those of *M. coccyx*, but with only slightly inflated upper part of the hypopygium. Schmitz [in Schmitz *et al.* (1938–1981)] stated that *M. tarsicia* is montane in Central Europe; he often found specimens from the Austrian Alps 1,000 m above sea level. It has a boreo-alpine distribution and is known from Austria, Switzerland, Germany, Norway and Sweden (Weber & Prescher 2004). In the present paper, the species is recorded for the first time from Iceland. The 12 specimens were caught on five sam-

pling sites in August. Again, nothing is known about the development of the larvae.

Only one or two specimens of other *Megaselia* species were sampled. *Megaselia humeralis* (Zetterstedt, 1838) is easy to recognize by the greatly thickened costal wing vein (Disney 1989). It is widely distributed in Northern and Central Europe, including Scandinavia and Great Britain (Disney 1991, Weber & Prescher 2004). In the present study, *M. humeralis* was found for the first time on Iceland. Its biology is unknown. *Megaselia quadriseta* Schmitz, 1918 belongs to the *Megaselia giraudii*-complex (Buck & Disney 2001). This complex includes several species morphologically very similar to *Megaselia giraudii* (Egger, 1862) that is abundant in Central Europe (Buck & Disney 2001). The same authors wrote that *M. quadriseta* “seems to replace the closely related *Megaselia giraudii* in boreo-alpine habitats of northern Europe”. *M. quadriseta* is widely distributed in Central Europe (Weber &

Table 4. Distribution of Phoridae species caught on Iceland, Greenland and the Faroe Islands (Schmitz & Beyer 1965, Disney 1991, 2004 and Weber & Prescher 2004). Abbreviations for countries follow the standards used in *Fauna Europaea* (<http://www.faunaeur.org>). Ice = Iceland; Faroe = Faroe Islands; Green = Greenland.

Species	Ice	Faroe	Green	Palearctic and other regions
<i>Diplonevra funebris</i> (Meigen, 1830)	No	Yes	No	AT, BE, CH, CZ, DE, DK-FOR, ES-CNY, ES-SPA, FI, FR-FRA, GB-GRB, GR, HU, IRE, IT-ITA, NL, PL, PT-AZO, PT-MDR, PT-POR, RU, SE, SK and YUYU; Nearctic
<i>Megaselia arcticae</i> Disney, 2004	No	No	Yes	Greenland
<i>Megaselia cirriventris</i> Schmitz, 1929	No	No	Yes	AT, ES-SPA, FI, FR, Greenland and SE; Nearctic
<i>Megaselia clara</i> (Schmitz, 1921)	Yes	No	Yes	AT, CZ, FI, Greenland, IS, NO-NOR, PL and SE; Nearctic
<i>Megaselia coccyx</i> (Schmitz 1965)	Yes	No	No	DK-DEN, ES-CNY, FI, GB-GRB, IS and SE
<i>Megaselia giraudii</i> (Egger, 1862)	Yes	No	No	AT, BE, CH, CZ, DE, DK-DEN, ES-CNY, ES-SPA, FI, FR-FRA, GB-GRB, HU, IS, IT-ITA, NL, NO-NOR, PL, PT-POR, SE and SK; Oriental and Nearctic Regions.
<i>Megaselia groenlandica</i> (Lundbeck 1901)	No	No	Yes	DK-DEN, FI, GB-GBR, Green-land, HU, SE and SK; Nearctic
<i>Megaselia humeralis</i> (Zetterstedt, 1838)	Yes	No	No	AT, BE, CH, CZ, DE, DK-DEN, FI, GB-GRB, HU, IRE, IS, NL, NO-NOR, PL, SE and SK.
<i>Megaselia nigra</i> (Meigen, 1830)	No	Yes	No	AT, BE, BG, CH, CZ, DE-DK-DEN, DK-FOR, ES-CNY, ES-SPA, FI, FA-FRA, GB-GRB, HU, IRE, NL, NO-NOR, PL, PT-AZO, PT-MDR, PT-POR, RU, SE and SK; Nearctic Region
<i>Megaselia parnassia</i> Disney, 1986	Yes	No	No	DE, GB-GRB, IS and SE
<i>Megaselia pleuralis</i> (Wood, 1909)	Yes	No	Yes	AT, BE, BG, CH, CZ, DE, DK-DEN, ES-CNY, ES-SPA, FI, FR-FRA, GB-GRB, Greenland, HU, IRE, IS, IT-ITA, NL, NO-NOR, PL, PT-AZO, PT-MDR, PT-POR, RO, RU, SE, SK and YUYU; Nearctic Region
<i>Megaselia pumila</i> (Meigen, 1830)	Yes	Yes	No	AT, BE, CH, CZ, DE, DK-DEN, DK-FOR, ES-SPA, FI, FR-FRA, GB-GRB, HU, IRE, IS, IT-ITA, NL, NO-NOR, PL, PT-POR, RU SE, SK and YUYU.
<i>Megaselia quadriseta</i> (Schmitz, 1918)	Yes	No	No	AT, CZ, DE, DK-DEN, GB-GRB, HU, NL, PL, PT-MDR, PT-POR, SK and IS
<i>Megaselia rufipes</i> (Meigen, 1804)	No	Yes	Yes	AT, BE, CH, CZ, DE, DK-DEN, DK-FOR, ES-CNY, ES-SPA, FI, FR-FRA, GB-GRB, Greenland, HU, IRE, IT-ITA, IT-SI, NL, NO-NOR, PL, PT-AZO, PT-MDR, PT-POR, RU, SE, SK and YUYU; Afrotropical, Australasian, Nearctic and Neotropical Regions
<i>Megaselia sordida</i> (Zetterstedt, 1838)	Yes	Yes	No	AT, BE, CH, CZ, DE, DK-FOR, ES-SPA, FI, FR-FRA, GB-GRB, HU, IS, IT-ITA, NO-NOR, PL, RU, SE and SK; Nearctic Region
<i>Megaselia tarsicia</i> Schmitz, 1926	Yes	No	No	AT, CH, CZ, DE, DK-DEN, IS, NO-NOR, PL, SE and SK.
<i>Triphleba gracilis</i> (Wood, 1907)	No	Yes	No	AT, DE, DK-DEN, DK-FOR, FI, GB-GRB, HU, IRE, PL, SE and SK.
<i>Triphleba renidens</i> Schmitz, 1927	Yes	No	No	AT, BE, FI, GB-GRB, IS, NL, RU and SE

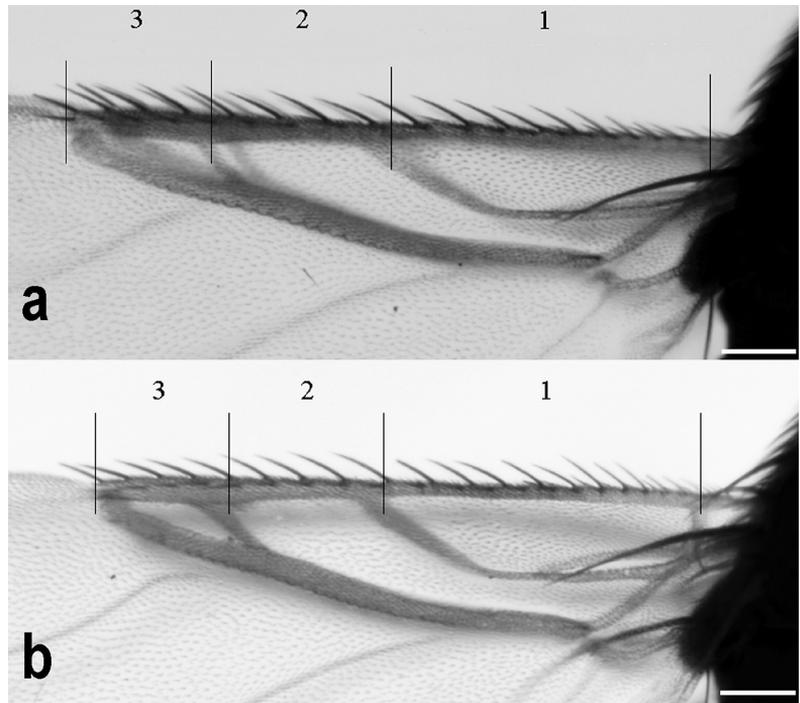


Fig. 2. *Triphleba renidens*. Males, right wing, ventral view, showing variation in size of the costal subdivisions 1 and 2 + 3. Costal subdivision 1 can be equal to (a) or longer than (b) the combined length of the costal subdivisions 2+3. Scale bars 100  $\mu$ m.

Prescher 2004), but it has not previously been found on Iceland. Larvae of *M. quadriseta* have developed in carrion traps baited with kidney and dead snails, and on lignicolous fungi (Buck 1997). *Megaselia parnassia* Disney, 1986 belongs, like *M. quadriseta*, to the *Megaselia giraudii*-complex, and has been recorded from Germany, Great Britain, Norway and Sweden (Disney 1991, Weber & Prescher 2004). Larvae of *M. parnassia* appear to be zoosaprophagous, having been found in carrion traps with kidney (Buck 1997).

Iceland is situated almost midway between Greenland (300 km to the west) and the Faroe Islands (450 km to the southeast); bioclimatically it falls in between the arctic Greenland and the atlantic/boreal Faroe Islands (Elvebakk *et al.* 1999). Comparing the phorid fauna of these three areas, however, reveals an overlap in five cases, but with no species simultaneously present on all three islands (Table 4). The species shared between Iceland and the Faroe Islands are *Megaselia pumila* (Meigen, 1830) and *Megaselia sordida* (Zetterstedt, 1838). *Megaselia clara* (Schmitz, 1921) and *Megaselia pleuralis* (Wood, 1909) are shared between Iceland and Greenland.

Although some of the species encountered on these islands show a wide Palearctic or Nearctic distribution (Table 4), about half of the species on each island have been caught on only one island; hence, no overlap is shown (Table 4: Iceland 6 of 11, Faroe Islands 3 of 6 and Greenland 3 of 6 species). The distribution of *Megaselia pleuralis* and the cosmopolitan *Megaselia rufipes* (Meigen, 1804) (Schmitz *et al.* 1938–1981) indicates that even more species are likely to be encountered on Iceland. These two species show a partial overlap among the northern Atlantic islands, but a complete overlap in the Canary Islands, the Azores and Madeira (Table 4). This suggests a more extensive distribution on Iceland, the Faroe Islands and Greenland. *M. rufipes* that is shared between the Faroe Islands and Greenland has not yet been recorded from Iceland but should also be expected to occur there.

Apart from *Megaselia*, only one additional genus was encountered on Iceland, containing only one species, viz. *Triphleba renidens* Schmitz, 1927. A total of 16 individuals was caught, including a single female that is considered here conspecific with the males (see below). According to Schmitz *et al.* (1938–1981), this

species has been found in Finland, Belgium, and The Netherlands. Additional findings have been made in Austria, Great Britain, Iceland, Sweden and Russia (Disney 1991, Weber & Prescher 2004). In this study, *T. renidens* was represented in five sampling sites among various types of habitats such as grassland, swamps and *Betula* forest (sites 1412, 1415, 1427, 1432 and 1434). In The Netherlands, *T. renidens* is active in spring, but in the northern part of its distribution the active period appears to be more extended (Schmitz et al. 1938–1981). Nothing is known about the biology of the larvae.

The male of *Triphleba renidens* is easily distinguished by the elongated left process of the epandrium; with a gently-curved hind margin and the basal part with a deep incision located at a centro-lateral position on the epandrium [see figure 113f in Schmitz et al. (1938–1981) and figure 2 in Disney (2001)]. *T. renidens* is furthermore distinguished by the shiny frons, as considered by Schmitz et al. (1938–1981) in their key to the Palaearctic species and in Disney (2001). However, the male specimens from the Iceland material occasionally key out incorrectly in Schmitz et al. [(1938–1981); page 140, key entry no. 23], at the key entry comparing the relative length of the three costal subdivisions [Schmitz et al. (1938–1981): page 47, figure text 44; see also Disney (1994): page 210, figure 8.5]. This is probably due to the fact that Schmitz et al. (1938–1981) did not realise the variability of the relative length measures of the subdivision of costa among *T. renidens* (Fig. 2a–b). This may also be the case for the single female specimen of *T. renidens* of the present study, which in Schmitz et al. (1938–1981) keys out as *Triphleba lyria* Schmitz, 1935. Additional facts supporting the finding of a female *T. renidens* are the shape of the sternite 7 (illustrated for the first time in Fig. 3), which is in close agreement with the description in Schmitz et al. (1938–1981): large, shovel-shaped, and with a hind margin that is broad and gently curved (see also Disney 2001). As only one species of *Triphleba* has been found on Iceland (Ólafsson 1991, present paper), we favour the hypothesis that the single *Triphleba* female is a *T. renidens*.

More Phoridae males (510) than females (80) were caught using the sweep net method. A predominance of males was also found in catches of



Fig. 3.  
*Triphleba renidens*.  
Female  
sternite 7.  
Scale bar  
100 µm.

emergence traps, sticky traps and suction traps (Disney 1994). Disney (1994) stated that the unbalanced sex ratio reflected difference in behaviour of the sexes. The males of many Phoridae species are more prone to dispersal than the females.

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