

**Notes on the feeding behavior of *Teratocoris saundersi*
(Hemiptera: Miridae) in Iceland:
phytophagy, zoophagy, and adventitious biting**

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Abstract. Host plants of the stenodemine mirid *Teratocoris saundersi* Douglas & Scott, 1869 in Iceland include the grasses *Agrostis capillaris*, *Deschampsia cespitosa*, *Elymus repens*, and *Leymus arenarius* (Poaceae), and sedges, *Carex* spp. (Cyperaceae). Specific host associations for *T. saundersi* in Iceland previously were unknown. Larvae and adults fed mainly on leaves and stems of their graminoid hosts; during cloudy weather, the bugs were observed in thatch beneath host plants. An adult fed on nectar from a flower of arctic sea rocket, *Cakile arctica* (Brassicaceae). Larvae and adults fed occasionally as predators or scavengers on small Diptera and pierced human skin. Observations on zoophagy further document the use of animal matter by species of *Teratocoris* Fieber, 1858, whereas adventitious biting by *T. saundersi* is reported for the first time. The zoophagous tendencies of *T. saundersi* might contrast with the feeding habits of stenodemines that are regarded as strict phytophages, for example, most species of *Stenodema* Laporte, 1833 and *Trigonotylus* Fieber, 1858.

Key words. Heteroptera, Miridae, Stenodemini, *Teratocoris*, feeding habits, host plants, trophic plasticity, Iceland, Palearctic Region

Introduction

The Miridae, or plant bugs, containing slightly more than 10,000 described species, are the most speciose of the heteropteran or true bug families (SCHUH & SLATER 1995, HENRY 2009). Mirids also exhibit great trophic diversity. Many species are opportunists that feed along a continuum between the extremes of strict phytophagy and strict zoophagy. Such species can be characterized as phyto-zoophages or zoo-phytophages, with their use of plant and animal matter depending on factors such as condition of the host plant for mainly phytophagous species and prey densities, in addition to availability of nectar and pollen, for mainly zoophagous species.

Plant-feeding mirids produce an array of symptoms that range from slight foliar chlorosis (in some cases, host plants remain asymptomatic) to shot-holing and tattering of foliage and lesions and cankers on stems. Predators include generalists that feed on a wide range of small arthropods and their eggs, as well as specialists on mites (Acari), planthoppers (especially Delphacidae), thrips (Thysanoptera), armored scale insects (Diaspididae), and lace bugs (Tingidae). Plant bugs of nearly all principal subfamilies and tribes also feed as scavengers (KULLENBERG 1944, WHEELER 2001, and references therein).

Zoophagy in the Miridae might be least developed in the subtribe Monaloniina (*sensu* SCHUH 1995) of the bryocorine tribe Bryocorini, and the mirine tribe Stenodemini. Stenodemines, however, feed occasionally as predators and scavengers (WHEELER 2001). Most of what is known about zoophagy in the genus *Teratocoris* Fieber, 1858 is the result of KULLENBERG'S (1944) monumental studies on the biology of Swedish Miridae. Herein, we present observations on the feeding behavior of *T. saundersi* Douglas & Scott, 1869 in Iceland, including phytophagy, zoophagy, and adventitious biting.

Material and methods

Host plants and feeding habits of *T. saundersi* were observed periodically (by JFS) in grasslands of Iceland from 2003 to 2009. Observations included Akureyri (ca. 65°40'N, 18°06'W) in the north, and Reykjavík (ca. 64°09'N, 21°57'W) and Eyrarbakki (ca. 63°52'N, 21°09'W) in the south. For observations of predation, scavenging, and biting, approximate times and weather conditions were recorded; several instances of zoophagy and biting were photographed. The principal host plants for observations were colonial bent grass (*Agrostis capillaris* L.) and European dunegrass (*Leymus arenarius* (L.) Hochstetter). Specimens of *T. saundersi* were identified by Thomas J. Henry, and voucher material has been deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC.

We refer to the piercing of human skin as 'adventitious biting'. We thus follow SCHAEFER (2000), who used that term to distinguish occasional or incidental biting from that of obligately haematophagous heteropterans such as cimicids and triatomine reduviids.

Results

Teratocoris saundersi Douglas & Scott, 1869

Taxonomy. *Teratocoris*, a Northern Hemisphere genus, comprises 10 species: four Holarctic, including *T. saundersi*; four Palaearctic; and two Nearctic (SCHWARTZ 2008). Described from Great Britain by DOUGLAS & SCOTT (1869), *T. saundersi* is a pale green or yellowish-green stenodemine mirid, with a median, longitudinal line on the head and pronotum; the collar and scutellum often are black. Adults vary in color, overall size (♂: 4.2–5.6 mm; ♀: 5.2–6.4 mm), and length of the antennae and legs. Females typically are brachypterous (BUTLER 1923; KULLENBERG 1944; WAGNER & WEBER 1964; KELTON 1966, 1980; WOODROFFE 1967). According to FRISTRUP (1945), all females are brachypterous in Iceland, whereas males vary in wing length; LINDROTH et al. (1973) stated that most specimens in Iceland are brachypterous. SCHWARTZ (2008) referred to wing dimorphism in this plant bug as submacropterous

rather than brachypterous. Examination of the male and female genitalia is needed to confirm identifications based on antennal, pronotal, and other characters. The left margin of the male genital capsule bears a slender, angular process; the fifth abdominal segment of the female bears a small median process (KELTON 1966, 1980).

Names considered junior synonyms of *T. saundersi* are *T. flori* J. Sahlberg, 1873, described from Russia; *T. herbaticus* Uhler, 1887, described from Labrador, Canada; and *T. lineatus* Wagner, 1952, described from Germany, Holland, Russia, and Sweden (SCHUH 1995, 2009; KERZHNER & JOSIFOV 1999).

Distribution. *Teratocoris saundersi* has been termed an ‘arctic-alpine’ (SOUTHWOOD 1957) or ‘circumarctoboreal’ (VINOKUROV 1988) plant bug. In North America, it is known from Canada (British Columbia, Labrador, Manitoba, Newfoundland, Northwest Territories, Nunavut, Quebec, Saskatchewan, and Yukon Territory) (KELTON 1966, MAW et al. 2000) and the northern United States (Alaska, Colorado, and Wyoming) (WHEELER & HENRY 1992). The extensive European range includes Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Latvia, the Netherlands, Norway, Poland, Russia (Central European & Northern Territory), and Sweden. In Asia, *T. saundersi* is known from China (Northern Territory) and Russia (East & West Siberia and Far East) (KERZHNER & JOSIFOV 1999).

Overview of bionomics. Host plants in Canada are *Carex* and *Scirpus* spp. (Cyperaceae) and ‘grasses’ (SCUDDER 1997), including *Calamagrostis* sp. (Poaceae) (KELTON 1966). Typical Eurasian habitats are bogs, marshes, and other wetlands, as well as meadows and steppe slopes (KULLENBERG 1944, SOUTHWOOD & LESTON 1959, VINOKUROV 1988). This univoltine plant bug overwinters in the egg stage. Larvae feed mainly on the vegetative and reproductive structures of various graminoids: grasses, rushes (Juncaceae), and sedges (KULLENBERG 1944, SOUTHWOOD & LESTON 1959). Among numerous hosts in Sweden, the rush *Juncus gerardii* Loisel, the sedges *Scirpus* spp., and the grass *Puccinellia maritima* (Hudson) Wahlenberg (as *Glyceria distans maritima*) are especially important. Its host range in Sweden is broader than that of *T. antennatus* (Boheman, 1852), which often co-occurs with *T. saundersi* (KULLENBERG 1944). In Britain, *T. saundersi* uses the same three hosts considered primary in Sweden, in addition to the sedges *Eleocharis* sp. and *Schoenoplectus tabernaemontani* (K. C. Gmelin) Palla and the grass *Phragmites australis* (Cavanilles) Trinius ex Steudel (SOUTHWOOD & LESTON 1959). *Teratocoris saundersi* is mainly phytophagous but occasionally feeds on aphids, adults and pupae of small Diptera, and pupae of Hymenoptera. In Sweden, its tendency toward zoophagy appears to be less than that of *T. antennatus*. Mating begins in Sweden by late June to early July and continues until mid-July, with adults present until mid-August (KULLENBERG 1944). In the British Isles, adults are found from mid- to late July until October (SOUTHWOOD & LESTON 1959). Adults in parts of northern Asia (Yukutia in the Russian Far East) appear by early July (STEPANOV 2008).

FRISTRUP (1945) noted that this plant bug’s range in Iceland is limited to areas dominated by grasses and sedges. The bug is regarded as a halobiont in Sweden (KULLENBERG 1944), but in Iceland it is not restricted to coastal areas (FRISTRUP 1945, LINDROTH et al. 1973). Larvae in Iceland are found in early summer, with adults first appearing in June (FRISTRUP 1945).

Observations on host plants and feeding habits in Iceland

Phytophagy. In lowland areas of northern and southern Iceland, *T. saundersi* is common not only in wetlands but also in dry meadows. Beginning the first half of July 2003, the bugs frequently were observed on colonial bent, *Agrostis capillaris*, a common rhizomatous and stoloniferous grass in Iceland (e.g., HELGADÓTTIR & SNAYDON 1986), JÓNSSON et al. 2006). Under sunny conditions, adults and larvae fed on leaves and stems of *A. capillaris* and, in wetlands, on sedges (*Carex* spp.). When the weather was dull, however, larvae were not seen on their hosts but were found beneath by digging into the thatch (ca. 7.5 cm thick), which consisted of previous seasons' graminoid leaves and stems. Host plants also included the grasses *Deschampsia cespitosa* (L.) P. Beauvois, *Elymus repens* (L.) Gould, and *Leymus arenarius* (Fig. 1). The coloration of adults and larvae is similar to that of their graminoid hosts.

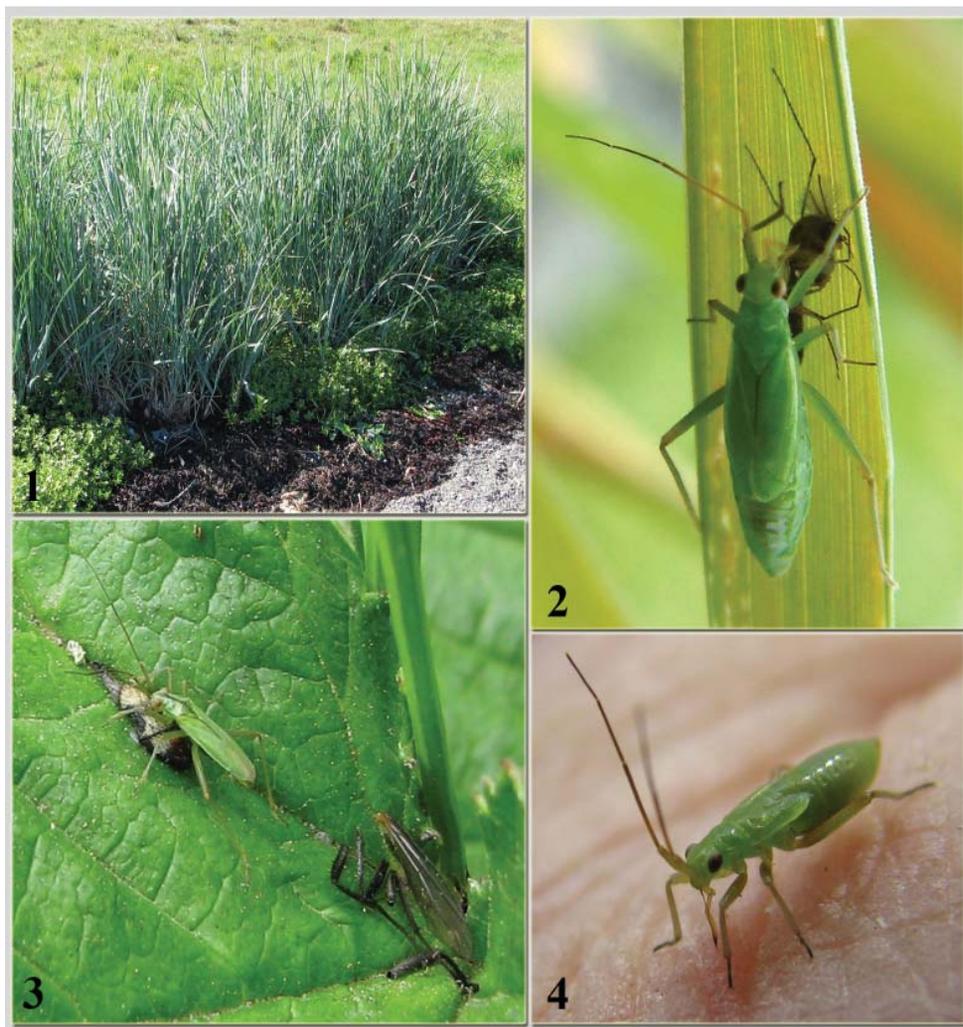
An adult once (Eyrarbakki, 7.vii.2008, sunny, 11:00 hr) fed on nectar from a flower of arctic sea rocket, *Cakile arctica* Pobedimova (Brassicaceae) on a sandy shore with dense stands of *Leymus arenarius*. The occasional presence of larvae on *Alchemilla filicaulis* Buser (Rosaceae) might be incidental because this plant bug is known to develop only on graminoids. Alternatively, larvae might wander onto a nearby plant of this herb to feed on animal matter (see Fig. 3) or flower nectar. Other insects are known to seek nectar from the inconspicuous flowers of *Alchemilla* spp. (KNUTH & MÜLLER 1908: 342). Nectar feeding is common in Miridae, with adults sometimes dispersing from their true hosts to take nectar from plants on which larvae do not develop (WHEELER 2001: 231).

Zoophagy. The distinction between predation and scavenging in heteropterans often is blurred because it is not known if the organism being fed on was killed or already dead (COBBEN 1978, WHEELER 2001). The observation of an adult *T. saundersi* feeding on a chironomid fly (Reykjavík, 28.vii.2004, partly sunny, 09:00 hr) was thought to represent predation (Fig. 2). An adult scavenged on the remains of a small fly (Reykjavík, 26.vi.2008, sunny, 14:00 hr) that previously might have been fed on by an unknown predator (Fig. 3). An adult also fed on a small fly (Reykjavík, 1.vii.2009, 14:00 hr) as either a predator or scavenger.

Adventitious biting. When *T. saundersi* first explored human skin, the bug's behavior quickly was terminated by blowing away the offending individual, but similar explorations of skin by larvae or adults were allowed to continue. A fifth instar (Akureyri, 23.vi.2007, bright sunshine, 09:00 hr) pierced skin on the hand and imbibed fluids for almost 7.5 min while the bug was photographed (Fig. 4). An adult (Reykjavík, 26.vi.2008, 14:00 hr, sunny) also pierced skin and drew fluids.

Discussion

CARVALHO (1959) did not list *T. saundersi* from Iceland in his world catalogue of the Miridae, and Iceland was omitted from the distribution cited by WHEELER & HENRY (1992) in their review of North American Miridae common to the Old and New Worlds. This mirid, however, was reported from Iceland by LINDROTH (1931: 148), as noted by FRISTRUP (1945). It also is among the insects that have colonized Surtsey, the small (2.7 km²) volcanic island that emerged off Iceland's south coast (29 km from the nearest mainland point) in November 1963; volcanic eruptions continued until 1967 (LINDROTH et al. 1973; FRIDRIKSSON 1975,



Figs. 1–4. *Teratocoris saundersi* Douglas & Scott, 1869 in Iceland: host plant and feeding habits. 1 – *Leymus arenarius* (Poaceae), a host plant on sandy shore, Reykjavík; 2 – female preying on a chironomid fly on the grass *L. arenarius*; 3 – male scavenging on a fly on thinstem lady’s mantle, *Alchemilla filicaulis* (Rosaceae); 4 – fifth instar piercing human skin (‘adventitious biting’).

1987; ÓLAFSSON & INGIMARSDÓTTIR 2009). The mirid presumably reached Surtsey by aerial dispersal, probably from the Icelandic mainland or adjacent islands. *Teratocoris saundersi* is known from the nearby Westman Islands, some of which constitute the land areas nearest Surtsey. Westman records include Heimaey (16 km²), the largest island of the group, and the small island of Sudurey (LINDROTH et al. 1973).

Iceland’s insect fauna is depauperate (MATHESON 1947), conforming to the general pattern of low biotic diversity in boreal regions of Europe and North America (e.g., FISCHER 1960,

PLATNICK 1991, GASTON 1996). Icelandic insects are nearly all of European origin, with the Nearctic element representing less than 1 % of the fauna. The island's fauna appears to have immigrated from Europe during an interglacial period when land extended more into the North Atlantic (LINDROTH 1931, 1957). Only one other mirid species, *Pachytomella parallela* (Meyer-Dür, 1843), is listed from Iceland in the most recent catalogue of Palaearctic Heteroptera (KERZHNER & JOSIFOV 1999). An orthotyline of the tribe Halticini, *P. parallela* also was reported first from Iceland by LINDROTH (1931). FRISTRUP (1945) noted that because only two specimens of *P. parallela* were known from Iceland, it might be only a 'casual visitor'. This plant bug now is established in Iceland (Skaftason, unpubl.).

Since FRISTRUP's (1945) notes on biology, little additional information on the bionomics of *T. saundersi* on the Icelandic mainland appears to have been published. Recent references to this plant bug in Iceland include its listing among invertebrates captured in pitfall traps in hayfields and pastures (GUÐLEIFSSON & BJARNADÓTTIR 2002) and collection in a study of the effects of long-term use of fertilizers on hayfield invertebrates (GUÐLEIFSSON 2002).

The observations reported herein apparently provide the first specific host-plant records for *T. saundersi* in Iceland and the first records of adventitious biting by this plant bug. Stenodemines sometimes have been considered strictly phytophagous (e.g., SOUTHWOOD & LESTON 1959, McNEILL & SOUTHWOOD 1978, GIBSON 1980, DOLLING 1991) despite KULLENBERG's (1944) observations of zoophagy by *T. antennatus*, *T. saundersi*, and other Stenodemini in Sweden. Our records of predation and scavenging by *T. saundersi* in Iceland further document zoophagous tendencies in this mostly phytophagous plant bug. Species of *Teratocoris* might tend more toward zoophagy than do species of certain other stenodemine genera, such as *Stenodema* Laporte, 1833 and *Trigonotylus* Fieber, 1858 (KULLENBERG 1944). Trophic plasticity, however, characterizes the Miridae (WHEELER 2001). Further study of stenodemine feeding habits, involving *Teratocoris* and genera in the same clade (*Actinocoris* Reuter, 1878, *Myrmecoris* Gorski, 1852, and *Pithanus* Fieber, 1858; Schwartz 2008) and in other clades, may yet reveal that zoophagous tendencies in Stenodemini are as well developed as those of most other mirid groups.

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