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SHORT NOTE

The first detection of the alien species: green-peach aphid *Myzus* (*Nectarosiphon*) *persicae* (Insecta, Hemiptera, Aphididae) in the Svalbard archipelago

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Abstract
Although the high Arctic archipelago Svalbard is among the best-studied Arctic regions in terms of biodiversity, its aphid fauna is extremely limited. Two endemic species have been described to date, and no species of a foreign origin has been registered. Our observation is the first record of the non-native and potentially invasive green-peach aphid species *Myzus* (*Nectarosiphon*) *persicae* (Insecta, Hemiptera, Aphididae), which was collected on the largest island of the archipelago—Spitsbergen. The green-peach aphid was found on three different ornamental plants: *Viola tricolor* (Violaceae), *Dianthus caryophyllus* (Pink Kisses) (Caryophyllaceae) and *Petunia* × hybrida (surfinia) (Solanaceae). The plants were displayed in front of one of the shops in the main street of Longyearbyen, the largest populated settlement of Svalbard. The infected plants came from the only supermarket on the archipelago, which had brought them from the mainland of Norway. Although the aphids (winged and wingless viviparous females and immature ones) were clearly visible on all of the plants (the distinct colonies from few to numerous individuals), the owners were not aware that the plants were infected. Similarly, the supermarket staff who are responsible for the live green plants did not register the presence of aphids on the imported plants. In this context, our results also suggest that a stricter approach to regional biosecurity needs to be considered in order to avoid the risks of further unintentional introductions.

Keywords High arctic · Biological invasion · Macrosiphini · Pest species

Introduction

The high Arctic archipelago Svalbard is among the best-studied Arctic regions in terms of biodiversity (Prestrud et al. 2004; Johansen et al. 2012). Despite its isolation, invasions have also occurred in this area and are widely recognised as constituting a serious risk to the Arctic region (Coulson et al. 2013; Wisz et al. 2015). Additional factors are the rapid climate change in the region and increases in human activity (Ware et al. 2011, 2014, 2016). Most of the alien species that have been introduced to Svalbard are plants. The percentage of alien plant taxa that was recorded in Svalbard (57%) compared to native species is higher than that recorded in other Arctic regions (Alsos et al. 2015). The highest species diversity and abundance of aliens were recorded in or close to the human settlements of Barentsburg, Pyramiden or Longyearbyen on the largest island Spitsbergen (Liška and Soldán 2004; Roalsø 2012). However, in the harsh Arctic conditions, only a few of the introduced plant species have established stable populations (Alsos et al. 2007). The current alien terrestrial invertebrate fauna of Svalbard consists of a relatively few species and none of them have yet displayed invasive tendencies (Coulson 2015).

The aphid fauna of Svalbard is extremely limited and comprises two endemic species—*Acyrthosiphon svalbardicum* (Heikinheimo) (Hodkinson et al. 2002) and *Sitobion calvulus* (Ossiannilsson) (Hodkinson et al. 2004). Non-native species of this group of insects have not as yet been recorded.

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During the investigation, which was conducted in August 2018, we had the opportunity to collect aphids (Insecta, Hemiptera, Aphididae) in Longyearbyen, which is the largest settlement in Svalbard, and its vicinity, as well as in the research town of Ny-Ålesund, both of which are located on the island of Spitsbergen in Svalbard. One of the results of our field study revealed the first detection of the alien aphid species *Myzus* (*Nectarosiphon*) *persicae* (Sulzer) in the Svalbard archipelago. The green-peach aphid is a polyphagous generalist that is globally distributed and is listed among the 14 species of the greatest economic importance that has a pest status (van Emden and Harrington 2007).

Materials and methods

Longyearbyen is the largest populated settlement on the Svalbard archipelago, and is located in the High Arctic, 78° North. Longyearbyen lies on Spitsbergen on the southern side of Adventfjorden, and is stretched out along the Longyear River. The surveys that are reported here were primarily carried out in the town and its vicinity (Fig. 1).

The investigation was conducted for a period of two weeks from 10 to 24 August 2018. The permission for the research application for RiS-ID 10,994 (including aphid collection) was issued by the Governor of Svalbard.

The aphids were collected directly from the host plants with a fine hair brush and placed into Eppendorf tubes containing 70% ethanol. The location, sampling date and host plant name were recorded on the labels that were placed onto the tubes. Adult wingless or winged females were slide-mounted using the method of Kanturski and Wieczorek (2012) and identified to the species level. The slides were examined using a Nikon Ni-U light microscope equipped with a phase contrast system. Field photographs were taken using an iPhone 7 camera with the OlloClip Macro Pro Lens Set. Samples were identified by K. Wieczorek based on their morphological diagnostic features using the standard literature-based keys (Blackman 2010; Blackman and Eastop 2006, 2018). The aphid material is deposited in the collection of the Department of Zoology, University of Silesia in Katowice, Katowice, Poland (DZUS):

DZUS 23/8.18_6 *Myzus* (*Nectarosiphon*) *persicae*, three alate viviparous females, Longyearbyen, Norway, 23.08.2018, *Viola tricolor*, K.Wieczorek leg.; DZUS 23/8.18_7 *Myzus* (*Nectarosiphon*) *persicae*, two alate viviparous females, one apterous viviparous female, Longyearbyen, Norway, 23.08.2018, *Dianthus caryophyllus* (Pink Kisses), K.Wieczorek leg.; DZUS 23/8.18_8 *Myzus* (*Nectarosiphon*) *persicae*, four alate viviparous females, Longyearbyen, Norway, 23.08.2018, *Petunia* × hybrida, K.Wieczorek leg.

Results and discussion

Living specimens of a virginoparous generation of *Myzus* (*Nectarosiphon*) *persicae* were collected from plants displayed in front of one of the shops in the main street of Longyearbyen (78°13′02.77″N 15°38′08.69″E) (Fig. 1).

Fig. 1 Collecting area

Aphids were found on three different decorative plants: *Viola tricolor* (Violaceae) (Fig. 2a), *Dianthus caryophyllus* (Pink Kisses) (Caryophyllaceae) (Fig. 2b) and *Petunia* × hybrida (surfinia) (Solanaceae) (Fig. 2c). All of these are annuals or short-lived perennials that are commonly used as ornamental plants. They can tolerate relatively harsh conditions.

The abovementioned plants are secondary hosts for *M.* (*N.*) *persicae* as its primary host *Prunus* spp. is absent in Svalbard. The highest density of adult and immature morphs were observed on *Viola tricolor* (on both sides of older leaves, Fig. 2d) and *Dianthus caryophyllus* (Pink Kisses) (under the inflorescence and between the petals, Fig. 2e,

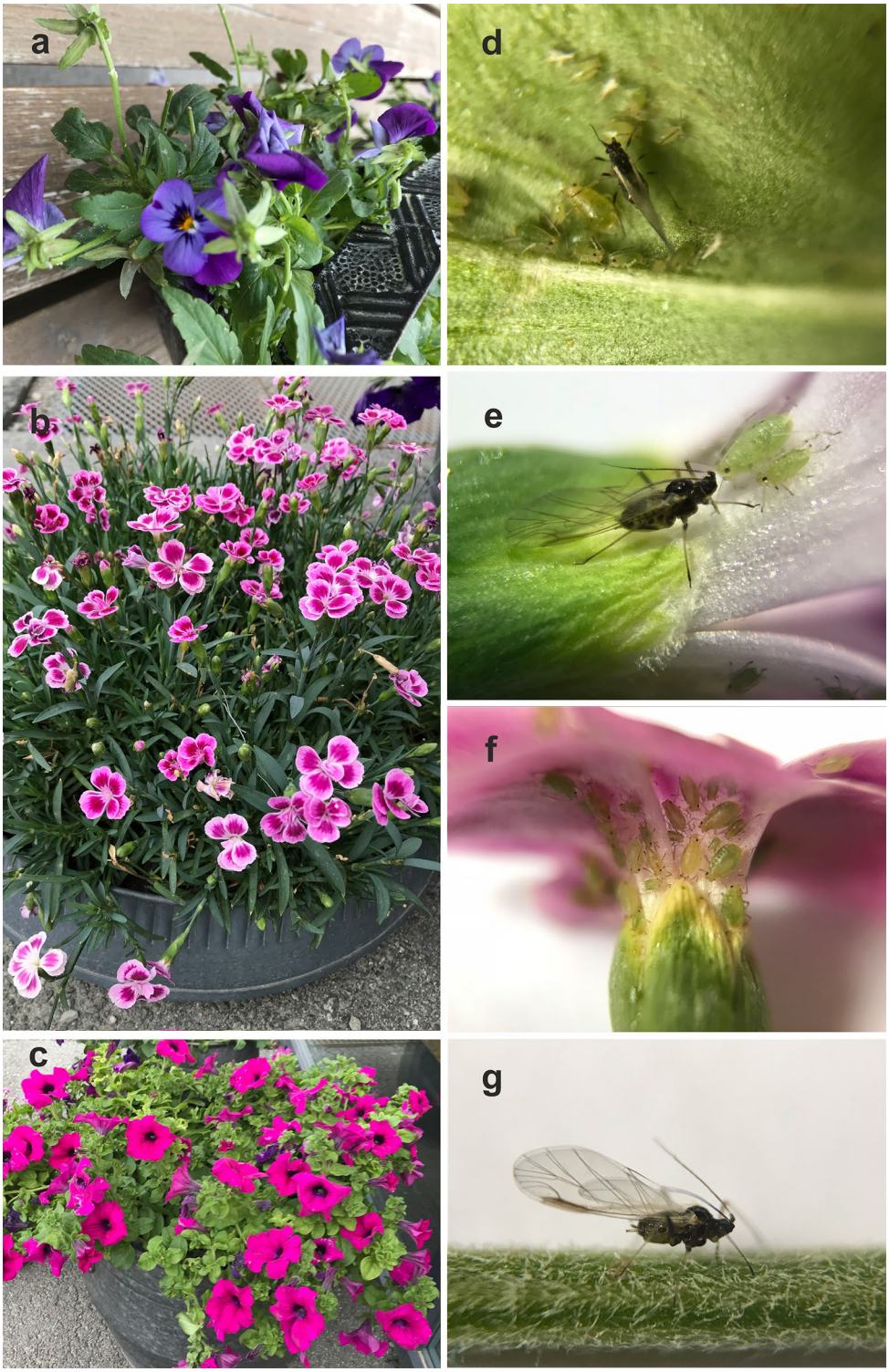

Fig. 2 The green-peach aphid *Myzus* (*Nectarosiphon*) *persicae* and its host plants: **a** *Viola tricolor*; **b** *Dianthus caryophyllus* (Pink Kisses); **c** *Petunia* × hybrida; **d**, **e** winged viviparous female and immature ones; **f** wingless viviparous females and immature ones; **g** winged viviparous female

Table 1 The number of morphs of the green-peach aphid *Myzus* (*Nectarosiphon*) *persicae* observed on its host plants

Myzus (*Nectarosiphon*) *persicae*	*Viola tricolor*	*Dianthus caryophyllus* (Pink Kisses)	*Petunia* × hybrida
Number of individuals			
Wingless viviparous females	17	21	
Winged viviparous females	11	13	19
Immature	24	38	

f). Surfinia was the least infested—only a small number of winged viviparous females were observed (Fig. 2g). The aphids were clearly visible on all the plants. The exceptions were the immature morphs, which were hidden in the petals of *Dianthus*. The immature morphs and winged morphs had the largest percentage share in the observed colonies (Table 1). Since neither oviparous females nor males (the sexual generation) were found in August and it is lack of its secondary host—*Prunus* spp., this species reproduces by anholocycly (permanent parthenogenesis) in high Arctic conditions of the Svalbard archipelago.

The infected plants came from the only supermarket on the archipelago, which had brought them from the mainland of Norway in June 2018. The plants were purchased also in June, and at the end of August, they were still in good condition with no visible signs of damage despite the aphids that were feeding on them. The owners of the plants were neither aware that the plants were infected nor of the presence of aphids. Similarly, the supermarket staff who are responsible for the live green plants did not register the presence of aphids on the imported plants. Although the average summer temperatures in Longyearbyen are quite low (3–7 °C), both the aphids and plants were in good condition, probably because they were kept in a closed room at night (which is required as polar bears roam through the town during the night). No other species of aphids (native or alien) or additional records of *M.* (*N.*) *persicae* in the studied area were found.

Unintentional introductions present the greatest threats to the Arctic and Antarctic ecosystems (Frenot et al. 2005; Snyder and Anions 2008; Chown et al. 2012; Hughes et al. 2015; Chown and Convey 2016; Chan et al. 2018). Alsos et al. (2015) stated that the ornamental plant trade and introduction through agriculture are of limited relevance in the high Arctic—only one observation of potato cultivation and one of the ornamental plant *Viola tricolor* exist, both from Longyearbyen. However, during our brief stay in Longyearbyen, we observed more examples of ornamental plants that were placed in front of shops or hotels and a wide variety of domestic pot plants available at the local supermarket. In this aspect, *M.* (*N.*) *persicae*, as a highly polyphagous species that is associated with more than 40 plant families and over 400 species (a secondary hosts) (Blackman and Eastop 2000), has also an advantage in colonising new areas. Moreover, it can transmit more than 100 plant viruses and its high levels of resistance to almost all classes of insecticides are well recognised (Bass et al. 2014). It has been proved that in similar harsh conditions, the introduced aphids, at least in some cases, prefer native host plants to exotic host plants (Hullè 2012). They can also transfer viruses (e.g. *Barley yellow dwarf virus*) to native plant species (Svanella-Dumas et al. 2013).

Our observation is the first one to record this non-native, potentially invasive and extremely harmful aphid species that has been collected in the archipelago. Whether the recorded population of *M.* (*N.*) *persicae* survived in small populations for a short time period and either died out naturally or were removed by human intervention (our recommendation for the owners was to destroy all infested plants) remains a speculation. However, our results suggest that a stricter approach to regional biosecurity needs to be considered in order to avoid the risks of further unintentional introductions. An additional challenge is to increase the public awareness of invasive and alien species of aphids in the fragile ecosystem of Svalbard. Such baseline information is critical for creating the appropriate management strategies.

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Author contribution KW and DCH designed the research, collected the insects and analysed the results. KW wrote the paper. DCH prepared the figures. Both authors have reviewed the paper.

Compliance with ethical standards

Conflict of interest The authors have no conflict of interest to declare.

Ethical approval This article does not contain any studies with human participants performed by any of the authors.

Human and animals rights All applicable international and national guidelines for the care and use of animals were followed. All proce-

dures performed in studies involving animals were in accordance with the ethical standards of the institution or practice at which the studies were conducted.

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