

Prokelisia marginata (Van Duzee, 1897) (Hemiptera, Delphacidae) recorded for the first time in Northern Europe

ANDERS ENDRESTØL & SVEIN ALMEDAL

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The Nearctic planthopper *Prokelisia marginata* (Van Duzee, 1897) (Hemiptera, Delphacidae) is native to the eastern coast of North America on its foodplant, the cordgrass *Spartina alterniflora* (Poaceae). Both the hostplant and subsequently the hopper itself has been introduced to Europe. *P. marginata* has been found in Europe since the mid-1990s and are now documented from eight central European countries and the UK. We here document the species for the first time from Northern Europe. As *Spartina* species are not, or to a very little extent, documented from Norway and that only one macropterous specimen of *P. marginata* was found, we expect this finding to be a result of a long-distance wind dispersal event from the UK or continental Europe to Norway in 2018.

Key words: Hemiptera, Delphacidae, *Prokelisia marginata*, new record, Norway, Northern Europe.

Anders Endrestøl, Norwegian Institute for Nature Research, Gaustadalléen 21, NO-0349 Oslo, Norway. E-mail: anders.endrestol@nina.no

Svein Almedal, Fløyfjellet 4A, NO-4640 Søgne, Norway

Introduction

The Nearctic planthopper *Prokelisia marginata* (Van Duzee, 1897) (Hemiptera, Delphacidae) is native to the Gulf and Atlantic coasts of North America. It also occurs along the central California coast (San Francisco Bay and nearby estuaries), where it may have been introduced (Grevestad *et al.* 2002). Both the hostplant of the hopper, the cordgrass *Spartina alterniflora*, and subsequently the hopper itself has been introduced to Europe, possibly on several occasions (Mifsud *et al.* 2010).

Spartina maritima is a cordgrass native to the coasts of western and southern Europe. The American cordgrass *S. alterniflora* was introduced to the UK in the early 19th century, probably as seeds in ballast (Thompson 1991). *S. alterniflora* later hybridized with the native *S. maritima* producing the sterile homoploid hybrid

S. x townsendii discovered in 1870 (Ranwell 1967). As a result of subsequent chromosome doubling, allopolyploidy, this hybrid produced a new species, *Spartina anglica* (Marchant 1968, Thompson 1991). High genetic variation within *S. anglica* indicate that this could have happened several times (Ayres & Strong 2001).

The colonizing efficiency, ability to stabilize mudflats and raising marshlands level of these grasses, resulted in them being introduced to several localities and countries. In 1967, *S. x townsendii* was established in nine countries worldwide (Ranwell 1967). *S. anglica* was first documented on continental Europe from France in 1906, where it spread naturally (references in Ranwell 1967), possibly with seeds and sea birds (den Bieman & van Klink 2016). *S. anglica* was planted on the Zeeland mud flats in the Netherlands for the first time in 1924 to strengthen coastal defences (den Bieman & van Klink 2016).

The species was also planted out in New Zealand (1913), Ireland (1920–1950), Belgium (1924), Tasmania (1927), Germany (1927), Australia (1930), Denmark (1931) in several areas, mainly to stabilize sediments, reclamation of marshland, commercial development and foreshore protection (references in Ranwell 1967, Thompson 1991, Sheehan & Ellison 2004, Miller 2004, Robb *et al.* 2009, Verloove 2019). In several regions and countries in Europe, the native *S. maritima* have been replaced with *S. x townsendii* or *S. anglica* (Ranwell 1967, Badmin & Witts 2009, Verloove 2019). *S. anglica* was introduced into China for the purposes of agricultural and ecological engineering in 1963 (Chung 1983, An *et al.* 2004). It is recently been discovered in Canada (Williams *et al.* 2004).

The first record of *S. anglica* in Scandinavia was done by Ferm (2007) in Rörö (an island west of Göteborg) in Sweden. The species is still established on the one locality in the country (ArtPortalen 2018). There are no known records of *Spartina* species from Finland to our knowledge. In Norway, a small experiment of planting out five specimens in a sheltered bay on a sand flat at Tjøme was carried out in the early 1980s (Christiansen & Møller 1983). According to Christiansen & Møller (1983) all the plants were gone after three years, probably due to ice. The exact locality of this experiment has not been possible to establish, so a hypothetical survival of this trial has not been possible to investigate. A few specimens of *Spartina* were reported from Tofte, Hurum in Norway in 2003 on a former timber import facility, but the exact species and possible status on the population is not known.

P. marginata was first published from Europe in Slovenia by Seljak (2004), but was already established in Algarve (Portugal) in 1994 and in Spain in 1998 (Wilson unpubl. data in Mifsud *et al.* 2010, Ouvrard & Soulier-Perkins 2012). This is the first example of a grassland Auchenorrhyncha introduced into Europe (Wilson & Mühlethaler 2009, Mifsud *et al.* 2010). The exact origin of the European populations of *P. marginata* is not known, but it has spread over the continent in 20 years (den Bieman & van Klink 2016). The species was documented with “enormen Massen

auf Schlickgräsern (*Spartina*)” in the south coast of England in 2008 (Wilson & Mühlethaler 2009) and on the east coast (Kent) in 2009 (Badmin & Witts 2009). It was also listed from France (2009) in Mifsud *et al.* (2010), documented in Ouvrard & Soulier-Perkins (2012). The species was found new to the Netherlands in 2010 in large amount, “several hundred in one sweep and about 1000 pr m²” (den Bieman & van Klink 2016). It was found new to Belgium in 2011 (De Blauwe 2011) and Germany 2011 (Stöckmann *et al.* 2013). No species of the genus *Prokelisia* is previously found in Northern Europe (Söderman *et al.* 2009).

The species

Prokelisia marginata (Van Duzee, 1897)

(Figures 1 and 2)

Record: VAY, Søgne: Amfenesmyra (EIS 2, UTM E428595, N6437677 ±75m) 4. November 2018, 1♀, leg. S. Almedal, coll. NINA, det. S. Almedal & A. Endrestøl.

One macropterous female specimen was found by sweep-netting on a small bog (100x100m) about 200 meters from the shoreline. The bog was dominated by *Myrica gale*, *Calluna vulgaris*, *Erica tetralix* and small individuals of *Pinus sylvestris*. The find was done by the second author after a period of extreme weather with strong, warm winds from the south. No *Spartina* specimen has been found in the area (see discussion). The locality was revisited and investigated at the end of May 2019 with negative results.

The following description is according to Wilson (1982): Males 2.3–4.1 mm, females 3.4–4.4 mm. Ground colour of head and thorax pale yellow to light brown, frons with dark brown longitudinal markings bordering median and lateral carinae, frons widest in basal 1/3, ca. 2x longer than wide, lateral margins outwardly convex and slightly sinuate. Forewings yellowish to hyaline.

P. marginata have wing-dimorphism, and the ratio of the wing-form is determined by crowding and host plant physiology (Denno *et al.* 1985). The species is bivoltine in the southern UK (Harkin 2016). On the Gulf Coast of Florida the species



FIGURE 1. *Prokelisia marginata* (Van Duzee, 1897). One macropterous female was collected at Amfenesmyra in Søgne municipality 4. November 2018. Photo. S. Almedal.



FIGURE 2. *Prokelisia marginata* (Van Duzee, 1897) has frons with dark brown longitudinal markings bordering median and lateral carinae. Photo: S. Almedal.

is multivoltine with at least five rather broadly overlapping generations (Denno & Grissell 1979). Key to adult specimen of *Prokelisia* based on external features and male genitalia can be found in Wilson (1982). Key to adult specimen of *Prokelisia* based on female genitalia can be found in Heady & Wilson (1990).

Nymphs and adults feed on the phloem sap of the intertidal grass *Spartina* (Denno & Grissell 1979). The original host plant for *P. marginata* is the American cordgrass *S. alterniflora* and the

closely related *S. foliosa* (Denno *et al.* 1987). Grevstad *et al.* (2003) tested the host-specificity of *P. marginata* prior to introducing it in Washington for biological control. They used no-choice tests on 23 potential species of nontarget plants and found *P. marginata* capable of completing its life cycle on *S. alterniflora*, *S. anglica* and *S. foliosa*, but not on e.g. *S. pectinata* and *S. gracilus* (Grevstad *et al.* 2003). Choice tests conducted by Harkin (2016) revealed that *P. marginata* showed a significant preference for *S. alterniflora* over *S. maritima* in the field. From Europe the species have been documented on *S. maritima* in Slovenia (Seljak 2004) and in Portugal (Wilson unpubl. data in Ouvrard & Soulier-Perkins 2012). It has been documented on *S. anglica* in the UK (Badmin & Witts 2009), the Netherlands (den Bieman & van Klink 2016) and in France (Ouvrard & Soulier-Perkins 2012).

Discussion

The appearance of *P. marginata* in Norway is highly unexpected, primarily because its hostplants have not, or to a very little extent, been recorded from Norway. Several delphacidae can have long-distance migration - exclusively macropterous individuals (della Giustina & Balasse 1999). We know from other examples that strong wind might facilitate the spread of alien species from the UK or the European continent to the Norwegian south coasts. One other alien hemiptera that had a strong influx to Norway and Scandinavia in 2018 was *Leptoglossus occidentalis* Heidemann, 1910 (Heteroptera, Coreidae) (Endrestøl 2019). This species is also documented on off-shore platforms (Endrestøl & Hveding 2017). Such installations have been suggested to serve as a stepping stone in the spread of alien species (Baust *et al.* 1981), and Sparks *et al.* (1986) actually documented *P. marginata* on an unmanned oil platform located 32km from the shoreline in the Mexican Gulf.

P. marginata is a strong flier, but trade could also possibly have facilitated the spread of this species as it is often found near harbours (De Blauwe 2011). Several other alien Auchenorrhyncha species have been documented

in Norway in the recent years as a result of trade with garden plants (e.g. Endrestøl 2008, Endrestøl *et al.* 2016, Endrestøl 2017), but we do not expect this to be the case with *P. marginata* as there are limited trade with *Spartina* grass in Norway to our knowledge (we have seen *S. pectinata* in trade in Norway, but this is not considered a host-plant for *P. marginata*, see Grevstad *et al.* 2003).

In North America, as in other parts of the world, some species of *Spartina* and their hybrids are considered major pests (Strong 2004). In Europe, *Spartina anglica*, has been referred to as one of “the 100 Most Invasive Alien Species” (Minchin 2009, Nentwig *et al.* 2018). They are potent ecosystem engineers, and mechanical removal and herbicides application to fight *Spartina* are very expensive (Strong & Ayres 2013). Major efforts have been taken to control these weeds, both chemically and biologically (Strong 2004, Grevstad *et al.* 2004). One of these measures was the release and introduction of *P. marginata* in Willapa Bay, Washington, which according to Grevstad *et al.* (2003) is the first example of a grass that has been targeted for classical biological control and the first application of classical weed biocontrol in a marine intertidal environment. Grevstad *et al.* (2003) found that in field cages, *P. marginata* reduced *S. alterniflora* biomass by 50 % and plant height by 15 % in comparison to planthopper-free controls when exposed to the planthoppers for approximately three months. In 2000 and 2001 they released 65000 individuals on each of three sites (Grevstad *et al.* 2003). A follow-up study on these effects in the area was not possible as the State agencies involved decided to implement a significant programme of herbicide application across Willapa Bay (Grevstad, pers. comm. in Harkin 2016). Any damage that *P. marginata* can cause to the host plant could therefore have a positive effect on biodiversity, but a negative effect on coastal defence (den Bieman & van Klink 2016). A high variation in herbivore vulnerability among invasive *Spartina* genotypes is reported by Garcia-Rossi *et al.* (2003), including tolerant but non-resistant genetic variants. How a further invasion of *P. marginata* might effect native populations of *S. maritima* is not known, but Seljak (2004) states

that *P. marginata* could potentially pose a threat to the limited population of the native *S. maritima* along the Slovene coast. Harkin (2016) found *S. maritima* to suffer a significant negative impact of exposure to *P. marginata*, but not significantly different from other UK *Spartina* species.

So far, *Spartina anglica* is distributed from 48 to 57.5° N in coastal Europe (Gray & Mogg 2004), excluding Norway. But Gray & Mogg (2004) suggests that changing climatic conditions, “could kick-start *Spartina*’s stalled invasion”, and thus increase its distribution northwards, which will include Norway. Yet another *Spartina* grass, *S. densiflora*, have been introduced to Europe, probably by the lumber trade between South America and Spain (Nieva *et al.* 2001). Its invasion in the Gulf of Cádiz is a serious ecological problem there (Nieva *et al.* 2001), and the hybrid *S. maritima* × *densiflora* seems to increase with climate change, posing further threats to local biodiversity (e.g. the native and endangered species *S. maritima*) (Gallego-Tévar *et al.* 2019). Whether or not *S. densiflora* or *S. maritima* × *densiflora* can act as a host plant for *P. marginata* is not known to our knowledge.

We find it highly unlikely that *P. marginata* is established in Norway, but this paper documents that it has a significant spreading potential. The nearest known populations is some 500km away, with possible undiscovered Danish populations some 150km away. Further investigations on possible undiscovered populations of *Spartina*, and perhaps *P. marginata* in Norway should be undertaken, and a future northward expansion of these invasive species due to climate changes should be monitored.

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