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Fragmenta entomologica

Department of Biology and Biotechnology "C. Darwin"

University Press

Sapienza Università Editrice

Fragmenta entomologica, 53 (1): 81–84 (2021)

eISSN: 2284-4880 (online version)
pISSN: 0429-288X (print version)

Short scientific note

Submitted: November 9th, 2020 – *Accepted:* February 9th, 2021 – *Published:* March 15th, 2021
DOI: 10.13133/2284-4880/455

First records of the Oak bush-cricket *Meconema thalassinum* on three German North Sea islands (Orthoptera: Ensifera, Tettigoniidae)

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Abstract
We provide the first records of the Oak bush-cricket *Meconema thalassinum* on the three German North Sea geest islands Amrum, Föhr and Sylt, based on monitoring and citizen science. The presence of the Oak bush-cricket on these German islands is probably due to unintentional introduction.

Key words: Orthoptera, *Meconema*, monitoring, citizen science, range extension.

Introduction

Two species of bush-crickets of Meconematinae occur in Schleswig-Holstein (northern Germany), the Oak bush-cricket *Meconema thalassinum* (De Geer, 1773) and the southern Oak bush-cricket *M. meridionale* Costa, 1860. Both species are characterized by the lack of a stridulatory organ. Instead, they communicate by drumming with the hind legs on a leaf (Harz 1955). They are nocturnal and arboreal occurring in woods, hedges, parks and gardens and are carnivorous feeding on small insects (Schumacher 1980).

Meconema meridionale was first found in Germany in the 1960s and has since then spread northwards (e.g. Grünitz & Hochkirch 2007; Winkler & Haacks 2019). *Meconema thalassinum* is native to Germany. Both species can easily be distinguished, as *M. meridionale* is a flightless bush-cricket with rudimentary wings and *M. thalassinum* has fully developed wings and is able to fly.

During the last decades scientists are increasingly utilizing citizen science as a non-invasive method to collect information related to the distribution of species (e.g. Kleitou et al. 2019). Here, we present a combination of field research and citizen scientists' reports documenting the first records of the oak bush-cricket *M. thalassinum* for the three German North Sea islands Amrum, Föhr and Sylt.

There is seemingly a distinct east–west gradient in the abundance of the oak bush cricket in Schleswig-Holstein and especially from the western marshland records are extremely rare. So far, the oak bush-cricket was neither known from the coastal region, nor from the North Frisian Islands (Dierking 1994; Winkler 2000; Winkler & Klinge 2019) (Fig. 1). Here, particularly the three geest (lower moraine) islands Amrum, Föhr and Sylt provide suitable habitats, but no records were known till recently. A similar east–west gradient is found on the neighbouring Danish Jutland (Fugle og Natur 2020).

Material and Methods

The three German North Sea islands Amrum, Föhr and Sylt form a specific landscape (physical region). Contrary to the western mainland and islands south to them that are marshland, these islands are predominantly remains of glacial moraines, so called 'geest islands' (Schlenger et al. 1969). As no proofs of the oak bush-cricket were known from these islands (Dierking 1994; Winkler & Klinge 2019) (Fig. 1) a monitoring survey was started in 2020, specifically on Amrum. Additionally, one of us (SP) conducted a citizen science approach by an appeal in the online newspaper 'Amrum News'. All records were photographically documented. The localities and exact coordinates of the records are given in Table 1.

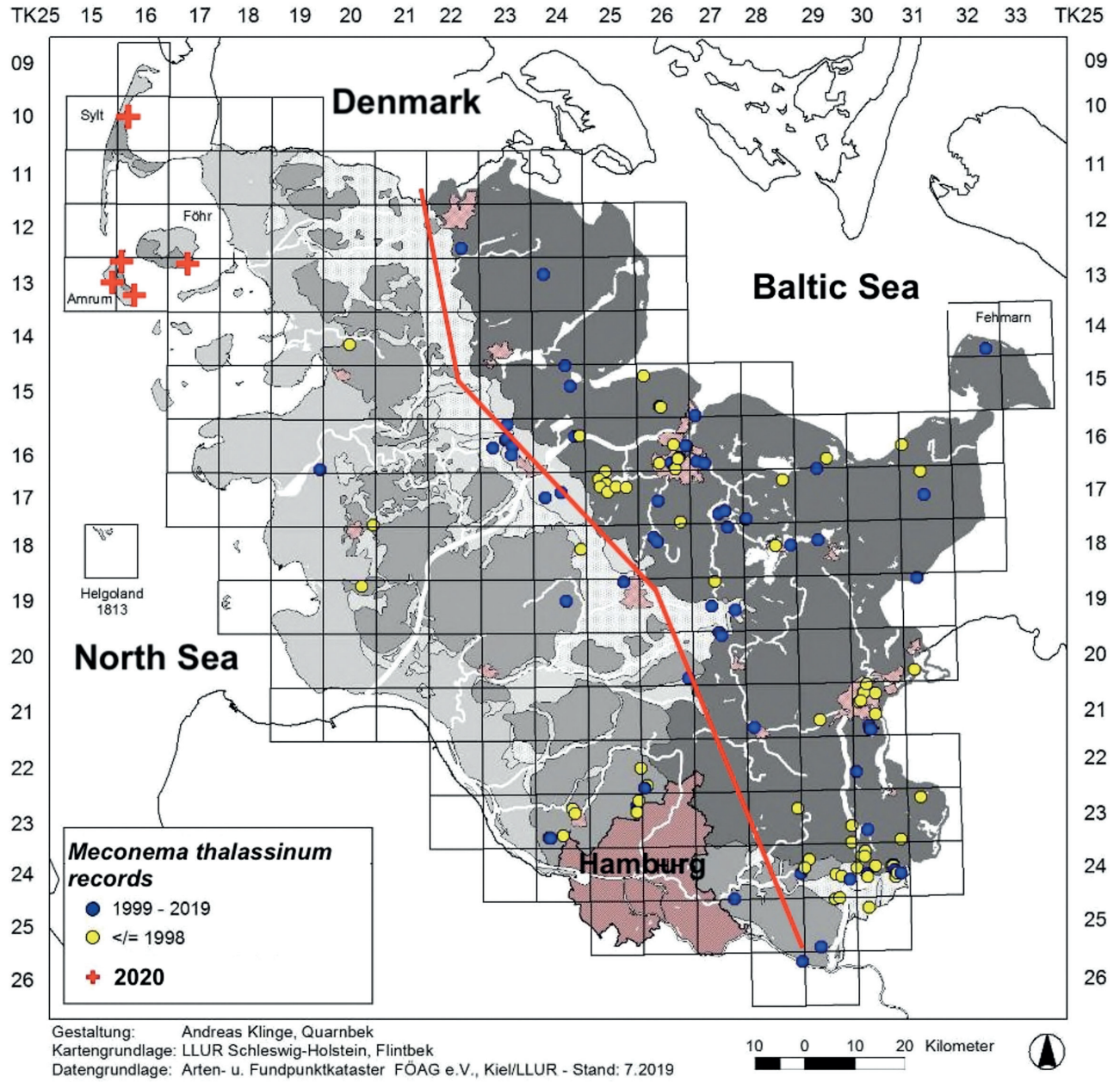

Fig. 1 – Distribution of *Meconema thalassinum* in Schleswig-Holstein (Germany). Solid red line indicates border between the Atlantic (west) and the Continental (east) Biogeographic Regions. Note majority of records are in the zone of the continental climate. From Winkler & Klinge (2019), modified.

Results

To date, 14 records of *M. thalassinum* from these islands are documented by voucher specimens or by in situ photographs. These are 10 records for Amrum, three records for Föhr and one record for Sylt. All records, except one from Föhr, are from summer 2020 (Table 1).

Amrum. On August 5, 2020 a male was collected in Norddorf, sitting on the muddy ground in a small wood consisting of *Alnus, Populus* and *Betula*. This specimen represents the first record of *M. thalassinum* for the island Amrum. All records from Amrum come from the three villages on the island, from Wittdün in the south, directly at the ferry pier, over Nebel in the middle of the island, up to Norddorf in the north (Table 1). The surroundings are characterized by village-typical green structures like gardens, hedges, single trees and bushes. All villages are located close to the Amrum forest area predominantly formed by deciduous trees, which acts as a connecting structure. Most of the specimens were found at terraces, inside buildings or in gardens. Just two records came from natural habitats (Table 1).

Föhr. On July 28, 2020 a female was photographed sitting on a bicycle on a public parking site in Wyk (Table 1). The surroundings are typical small city habitats (gardens,

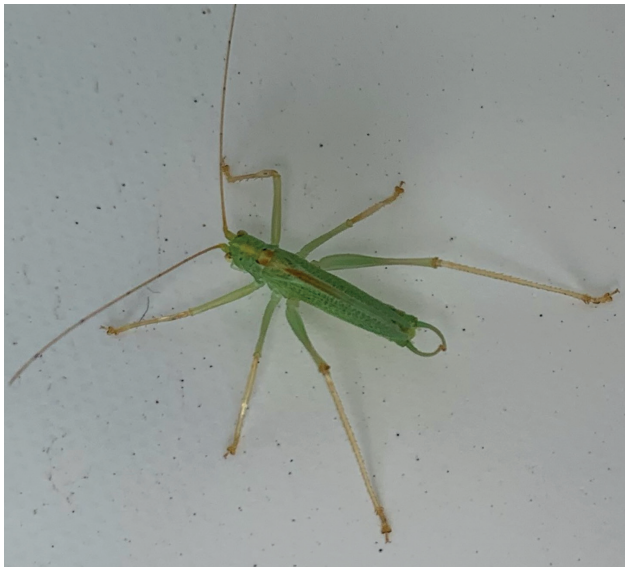

Fig. 2 – A male of the oak bush-cricket *Meconema thalassinum* from German North Sea Islands: island Sylt, 09 Sept. 2020, photo H. Ahnelt.

parks, single trees of different species) and the harbour with frequent car ferry services is located less than 200 m apart. Additionally, eight dead specimens were found from 2015 to 2019, but no exact documentation goes with this report (Table 1). These eight specimens (one female and seven males) represent the first record of *M. thalassinum* for the island Föhr and the first for the three German North Sea geest islands.

Sylt. On September 09, 2020 a male was photographed sitting inside a hooded beach chair on a private terrace at the north end of Kampen (Fig. 2, Table 1). The surroundings are dominated by beach rose *Rosa rugosa* but also deciduous trees and bushes (e.g. *Populus*, *Salix*, *Sambucus*) grow in close vicinity. The locality is on the north end of the central geest of Sylt. This specimen represents the first record of *M. thalassinum* for the island Sylt.

Discussion

Here, we report the first records of *M. thalassinum* for the three German geest islands Amrum, Föhr and Sylt. The Oak bush-cricket is common in Germany, but records in its most northern part, in Schleswig-Holstein, are patchy. Here, the Oak bush-cricket is mostly found in the eastern upper moraine landscapes. Towards west, on the lower moraine landscapes, records are becoming rare and in the western marshland and coastal regions this species seems to be virtually absent (Dierking 1994; Winkler & Klinge 2019) (Fig. 1). Probably it is overlooked in these areas (Dierking 1994; Winkler & Haacks 2019). This distribution pattern roughly corresponds to the border of the Atlantic and the Continental Biogeographic Regions that divides Schleswig-Holstein in a north–south direction (Fig. 1).

The origin of the Oak bush-cricket on these North Sea islands is not known. Three scenarios seem to be plausible to explain the recent occurrence of *M. thalassinum* on the three islands.

First, the Oak bush-cricket does not produce noisy songs as it is a non-stridulating species and is therefore often difficult to locate. Because of its cryptic and nocturnal life style this species might be overlooked for several years or decades.

Second, the Atlantic climate with its relatively cool summers, especially evident on the coastal regions (Christiansen & Schmidtendorf 1952), influenced the distribution of many

Island	Date	N/sex	Coordinates/location	Location	Proof
Föhr *	2015–2019	7/♂ 1/♀	54°42’13”N, 8°24’2”E or 54°41’19”N, 8°32’59”E	in building	photo, cs
Föhr	28/07/2020	1/♀	54°41’29”N, 8°33’57”E	parking site	photo, cs
Amrum *	05/08/2020	1/♂	54°41’6”N, 8°19’33”E	wet wood	voucher
Amrum	14/08/2020	1/♂	unknown/near Nebel	inside a car	voucher
Amrum	14/08/2020	1/♂	54°42’10”N, 8°19’27”E	in building	photo, cs
Amrum	15/08/2020	1/♂	54°51’10”N, 8°19’25”E	in building	voucher
Amrum	15/08/2020	1/♀	54°37’36”N, 8°23’38”E	terrace	photo, cs
Amrum	15/08/2020	1/♂	54°39’12”N, 8°21’3”E	in building	photo, cs
Amrum	17/08/2020	1/♂	54°40’54”N, 8°19’49”E	in building	photo, cs
Amrum	30/08/2020	1/♀	54°39’51”N, 8°19’28”E	humid wood	voucher
Amrum	31/08/2020	1/♂	54°51’10”N, 8°19’25”E	in building	voucher
Amrum	08/09/2020	1/♀	unknown/Steenodde	garden	photo, cs
Föhr	09/09/2020	1/♂	unknown/Wyk	in building	photo, cs
Sylt *	09/09/2020	1/♂	54°57’54”N, 8°20’36”E	terrace	photo (Fig. 2)

Table 1 – Records of the oak bush-cricket *Meconema thalassinum* on the German North Sea islands Amrum, Föhr and Sylt, in chronological order. cs – citizen science. * – first record for the respective island.

species, possibly also the Oak bush-cricket. East–west and also north–south gradients in the distribution or even range borders inside Schleswig-Holstein have been described for various grasshopper species (Winkler & Klinge 2019). Nevertheless, triggered by climate change temperature was rising during the last decades and enabled thermophilic species to extend their distribution area in Europe northwards, e.g. *Roeseliana roeselii* (Hagenbach, 1822) and *Meconema meridionale* (Orthoptera) (Grünitz & Hochkirch 2007; Hochkirch & Damerau 2009). Possibly, climate warming also favoured range expansion of the Oak bush-cricket. Sutton et al. (2017) mentioned a northward range expansion of this species in Great Britain and on mainland Europe. Possibly changes of climate conditions have lead to more suitable habitat conditions for *M. thalassinum*.

Third, unintentional introduction with material transports and/or hitchhiking on e.g. cars and ferries are a likely scenario for the recent occurrence of the Oak bush-cricket on the islands. Examples for such introductions are the Lesser white-toothed Shrew *Crocidura suaveolens* (Pallas, 1811) on Amrum and Föhr (Borkenhagen 2017) and the Common grass Snake *Natrix natrix* (Linnaeus, 1758) on Sylt (Böhme & Grell 2013). We hypothesize that the combination of more suitable habitat conditions due to climate and landscape change (extensive afforestations or settlement developments took part on all three islands) enabled unintended recent introductions to successfully colonize the islands. The combination of monitoring and citizen science was particular useful as effective tool for the detection of such a cryptic species like the nocturnal and 'silent' Oak bush-cricket.

Future investigations will provide information if the Oak bush-cricket was also able to establish on other German and Danish North Sea islands. It will need an integrative approach to evaluate if *M. thalassinum* has been overlooked so far or if the occurrence of this species was a recent event. In latter case, to determine the founder population(s) of the oak bush-cricket, detailed genetic investigations will be needed.

Acknowledgements – We would like to thank Nina Drews, Martina & Helmut Finkh, Thees Jagles, Claudia Jung, Lotte von Komorski, Anja Rappen, Lillith Schlöbcke, Jannes Schulz and Kai Wechsung for providing information and photographs and Christian Winkler for many helpful comments.

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