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Emergence of the Asian tiger mosquito, *Aedes* (*Stegomyia*) *albopictus* (Diptera: Culicidae) in two geographically separated Austrian provinces, May and September 2012

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Abstract

In May 2012 the Asian tiger mosquito, *Aedes* (*Stegomyia*) *albopictus* (Skuse, 1895), was found for the first time in Austria. Mostly larval stages were identified originating from the most southern district of Burgenland, an eastern Austrian federal state. In September 2012, *Aedes albopictus* larvae were identified in a north-eastern district of the Tyrol, in more than 400 km distance from the first site. Several models show that the first site is in a region potentially suitable for *Aedes albopictus*, whilst the Tyrolean Inn river valley is considered as not suitable for establishment. Both occurrences might correspond to a transient summer introduction of *Aedes albopictus*.

Key words: *Aedes albopictus*, Culicidae, Asian tiger mosquito, passive introduction, Austria.

Zusammenfassung

Zum Auftreten der Asiatische Tigermücke, *Aedes* (*Stegomyia*) *albopictus* (Skuse, 1895), in zwei geographisch getrennten österreichischen Bundesländern im Mai und September 2012. – Im Mai 2012 wurde die Asiatische Tigermücke, *Aedes* (*Stegomyia*) *albopictus* (Skuse, 1895), zum ersten Mal innerhalb von Österreich im Bezirk Jennersdorf im Burgenland unweit der ungarischen Grenze gefunden. Im September 2012 wurden Larven dieser Art in der Ortschaft Angath, im Unterinntal in Tirol, gefunden, in mehr als 400 km Entfernung vom ersten Fundort. Es gibt einige Modelle, welche die erste Region als mögliches Verbreitungsgebiet von *Aedes albopictus* ausweisen, nicht jedoch das Inntal in Tirol. In beiden Fällen muss von einer vorübergehenden sommerlichen Einschleppung ausgegangen werden. Eine Etablierung (d. h. reproduzierende Populationen) konnten bislang nicht festgestellt werden.

Introduction

It is widely anticipated that global change will impact the spread of vector-borne diseases in Europe by affecting the distribution area and the abundances of the vectors (European Centre for Disease Prevention and Control 2010, 2012a, b,

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Randolph & al. 2010). Some of Austria's indigenous mosquito species have already been shown to carry pathogens such as West Nile virus (WNV) (Bákonyi & al. 2006, 2013, Wodak & al. 2011), Usutu virus (USUV) (Seidel 2011) and Tahyna virus (TAHV) (Huemer & al. 2014). Exotic vectors, which are introduced by global trading activities on an intercontinental scale and by ground vehicles on a regional scale, have already been published for a number of countries in Europe (European Centre for Disease Prevention and Control 2012). This suggests that transmission of vector-borne diseases may become more frequent and may occur in regions that have not previously been affected.

Aedes albopictus (Skuse, 1895), the Asian tiger mosquito, is a main vector of dengue fever, chikungunya, and other tropical human diseases (Medlock & al. 2012). The health threat posed by exotic invasive mosquito species is substantially discussed elsewhere (Gould & al. 2010, Hendrickx & Lancelot 2010, Medlock & al. 2012). Here we report the detection of *Aedes albopictus* in two Austrian provinces. Firstly, in May 2012 in the southern part of Burgenland (Seidel & al. 2012), and secondly, in September of 2012 more than 400 km apart and separated by several Alpine mountain ranges in the northern part of the Tyrol. These findings contribute to evaluate projections of an ECDC technical report (European Centre for Disease Prevention and Control 2012) for predicting the climatic suitability for West Nile virus and Dengue virus transmission.

Materials and methods

The mosquito surveillance network established in Austria in 2011 is described on the web (http://www.ages.at, http://www.ages.at/themen/ages-schwerpunkte/vektoruebertragene-krankheiten/gelsen-monitoring/). In brief, mosquitoes are collected at a minimum of 37 locations across the Austrian territory twice per activity-season by catching blood sucking females and using Biogents® BG-sentinel mosquito traps baited with carbon dioxide. Approximately 5,000 adult mosquitoes are identified to species level each year, pooled according to species, location and time, and tested by various (RT-) PCR and q (RT-) PCR assays for the presence of nucleic acids of diverse human pathogens such as WNV, USUV, TAHV, and certain plasmodia (Seidel & al. 2013). Beside this WNV-surveillance-program of the Austrian mosquito fauna, diverse activities have been achieved e. g. larval sampling at suitable sites in particular done for an extensive population study on *Aedes japonicus*, the Japanese rock-pool-mosquito. A large quantity of material exists from this species, which was collected in three Austrian federal states without further DNA- or RNA-testing. A publication of the *Aedes japonicus* study is in preparation. Both remarkable findings of *Aedes albopictus* had their origins within the surveys gathering *Aedes japonicus*.

Voucher specimens were deposited at the Natural History Museum Vienna.

Results

Aedes albopictus was first detected in the most southern district of the Austrian federal state of Burgenland. On May 29th, 2012, several sites in southern Burgenland, at which this species had not been identified in 2011, were retested. More than twenty immature individuals and one hatched female of *Aedes albopictus* were collected at one site out from two rubber jars containing water at a storage yard near the town of Jennersdorf (46°56'15.1" N, 16°06'29.5" E; 245 m a.s.l.). Two samples from neighboring locations yielded larval specimens of *Culex* and *Ochlerotatus* only.

On September 15th, 2012, approximately 25 *Aedes albopictus* larvae were collected in the village of Angath (47°30'22.8" N, 12°03'54.5" E; 495 m a.s.l.) from a discarded plastic bucket containing rainwater, previously used for mixing construction materials. Angath is a village located near Wörgl in the lower Inn valley in the Austrian federal state Tyrol. The finding was situated in about 2 km distance of large motorway service areas located beside the motorway A12.

Discussion

In this paper the detection of *Aedes albopictus* is reported at two geographically distant locations in Austria in 2012. A model for predicting the climatic suitability for transmission of Dengue virus, commissioned by the European Centre for Disease Prevention and Control (2010) revealed that large parts of Austria were considered as potentially suitable for *Aedes albopictus*, including Burgenland. The mountainous regions of Tyrol including the Inn river valley, however, were considered as inappropriate for the vector. Two follow-up publications based on modeling predictions of the potential spread of vector-borne diseases in face of climate change confirmed again that the valley of the river Inn in western Austria is considered unsuitable for *Aedes albopictus* (Fischer & al. 2011, Thomas & al. 2011). Thus, our finding of the tiger mosquito in this valley may correspond to a transient summer introduction rather than to a spread with permanent establishment (Becker & al. 2013), but it will be necessary to determine the species' status in Austria. As *Aedes albopictus* was not detected during the sampling in 2011, its arrival time in southern Burgenland can be estimated for spring 2012. The origin of this alien species and the transport mode to this site in Austria remains unknown. The nearest established *Aedes albopictus* population is reported at a distance of 170 km, in a suburb of the Croatian capital Zagreb (Klobučar & al. 2006). In July 2012 we checked the site again and found *Aedes albopictus* replaced by *Aedes japonicus* (Theobald, 1901), another invasive species which has actively occupied the south-east of Styria and southern Burgenland since 2011. Its origin is the Far East. Our first record of this species was in the area of Kreuzberg near Leutschach in southern Styria and in the region of Maribor (Marburg) in Slovenia (Seidel & al. 2012). In the meantime this species even covered large areas of Carinthia, the whole southern Styria and it actively reached Hungary near the city of Szentgotthárd in August 2012. Since 1992 and 2006, respectively, large populations

of *Aedes albopictus* are known from Italy (Dalla Pozza & Majori 1992, Knudsen & al. 1996, Romi & Majori 2008). We recently checked a well-established population of the Asian tiger mosquito in the region of Tolmezzo and our most northern single finding was done at Resiutta – a climatically rough mountainous river valley site – in about 30 km distance from the Austrian border at Thörl-Maglern in September 2014 (B. Seidel, unpubl.).

In contrast, the second Austrian site of detection is in the economically busy Inn valley. An introduction of *Aedes albopictus* originating from established mosquito populations in the Italian province of Trentino via commercial or private transport is thus highly likely. Interestingly, *Aedes albopictus* has so far not been detected in other parts of the Tyrol before or after this finding in Angath until today.

The ability of biting diverse host species makes *Aedes albopictus* another potential bridge vector for West Nile virus, which has been rapidly spreading in recent years in central, southern and eastern Europe (see: http://ecdc.europa.eu/en/healthtopics/west_nile_fever/West-Nile-fever-maps/PublishingImages/West-Nile-fever-map-historical-data-high-res-221112.jpg).

In addition to its potential vector role, *Aedes albopictus* is also an aggressive daytime biting mosquito. If it succeeds in overwintering *Aedes albopictus* has the potential to become a significant pest in Austria because it closely associates with humans (rather than living in wetlands). Vector surveillance, including monitoring the spread of *Aedes albopictus*, provides a rational basis for developing public health measures that address the spread of viral diseases and their vectors. However, these scenarios of public threat make no sense until the Asian tiger mosquito can establish bigger populations such as the Asian bush mosquito (*Aedes japonicus*) which has been able to occupy most parts of southern Austria since 2011. The vector competence and the life history of this invasive species is almost the same as that of *Aedes albopictus* with even higher tolerance to the Austrian mountainous conditions.

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