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Short Communication

Retrospective search for dengue vector mosquito *Aedes albopictus* in areas visited by a German traveler who contracted dengue in Japan

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SUMMARY

A German traveler developed dengue fever in late August 2013, following a direct flight from Germany. Autochthonous dengue virus (DENV) infection has not been reported in Japan. To evaluate the risk of autochthonous DENV transmission in Japan, the authors performed a retrospective search of the five areas visited by the German patient to determine the population density of dengue vector mosquito, *Aedes albopictus*. The annual mean temperature of each area was higher than 12 °C, which is considered suitable for the establishment of *A. albopictus* populations. Our retrospective search revealed the population density of *A. albopictus* to be high in the urban areas of Japan.

1. Introduction

Aedes aegypti (Linnaeus) was detected at Tokyo Narita International Airport in 2012.[1] Currently, however, there are no data on *A. aegypti* infestations in urban residential areas in Japan. Dengue outbreaks occurred in Japan during World War II, at which time *Aedes albopictus* was the vector mosquito.[2] Of note, *A. albopictus* was reported to be the main vector in dengue outbreaks in Hawaii in 2001 and Reunion in 2012.[3,4] Climatological analysis using a geographic information system (GIS) showed that the current distribution of *A. albopictus* in Japan is strongly correlated with areas in which the annual mean temperature is higher than 11 °C.[5] Similarly, in Europe and the USA, the annual mean temperature of more than 94% of the *A. albopictus* infested areas is higher than 11 °C.[6] Since 2010, there has been a marked increase in the number of imported dengue cases reported in Japan, with 249 cases reported in 2013.[7] More than 70% of the imported dengue cases were confirmed during the mosquito breeding season from May to October.

Coincidentally, a German tourist contracted dengue in Japan in August 2013. The patient, who arrived in Japan on a direct flight from Germany, visited five urban areas, including Hiroshima, Kyoto, Fuefuki, Ueda, and Tokyo, during her 2 weeks of travel.[8] In this study, we determined the population density of *A. albopictus* in the areas visited by the tourist (or neighboring areas in the cases of Fuefuki and Hiroshima, from where sufficient data could not be obtained), in order to evaluate the risk of autochthonous dengue infection in Japan.

2. Mosquito surveillance in areas visited by the German patient

We used human bait collection (HBC), a method of catching mosquitoes by sweeping for 8 min with an insect net before mosquitoes land on the exposed surface of collectors. The average

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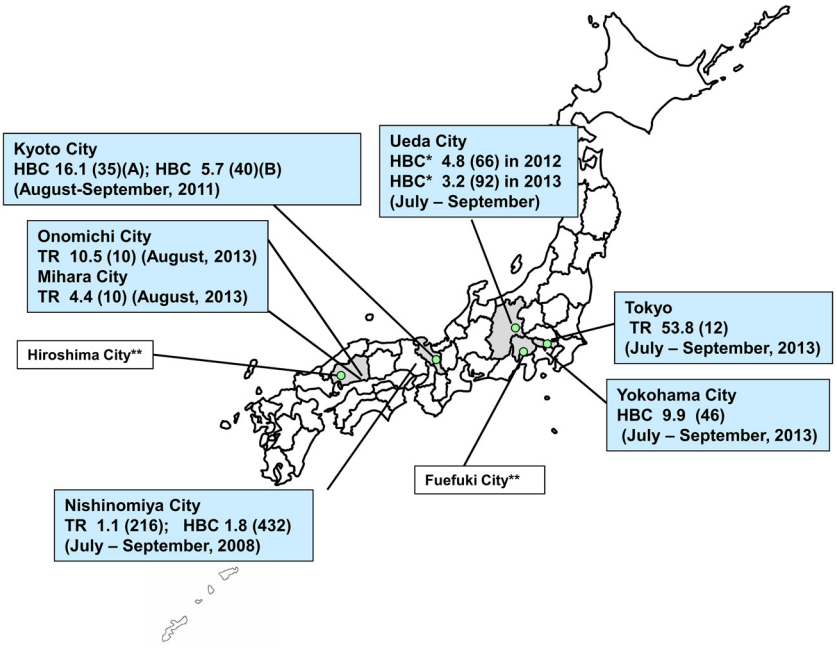

Figure 1. Average number of *Aedes albopictus* collected using human bait collection and CDC miniature traps in areas visited by the dengue patient and surrounding areas of Japan. Gray color shows prefectures visited by the German patient who was suspected to have contracted dengue fever in Japan. TR: CDC miniature trap (CDC trap); HBC: human bait collection with insect net for 8 min. The numbers in parentheses show the total number of CDC traps and the total number of samples collected by HBC using an insect net for 8 min. *In Ueda City, HBC was performed for 6 min for all of the mosquito collection sessions. **Records of mosquito collection in the cities of Fuefuki and Hiroshima were not found, although the German patient visited these cities.

numbers of mosquitoes collected by HBC in a residential house in Ueda City was 4.8 in 2012 and 3.2 in 2013 (Figure 1). In Kyoto, more than 10 mosquitoes were collected by HBC in two Japanese temples. These temples are historical sightseeing points that are commonly visited by domestic and international tourists. The results suggest that a stationary human host at a shaded point under a tree canopy and near bushes or vegetation in the vicinity of the temple would be exposed to attacks by more than 10 female mosquitoes within 8 min. In Yokohama, the collection site was a typical residential house, the garden of which was covered with plenty of vegetation. The average number of mosquitoes collected by HBC was almost 10, which is considerably high. It is hypothesized that rich vegetation in the gardens of residential houses and public spaces contributes to an environment that is suitable for harboring female mosquitoes, even when larval habitats are not constantly present in these environments.

A. albopictus was also collected by a CDC miniature trap enhanced with dry ice, which was set in public spaces in

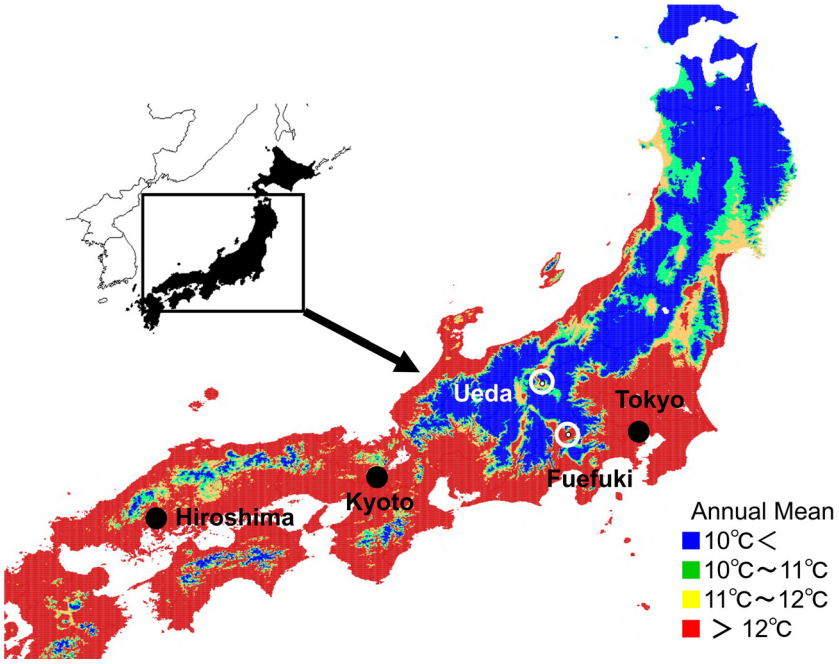

Figure 2. Distribution of areas with annual mean temperatures ranging from below 10 °C to above 12 °C in 2013. All areas visited by the German patient were above 12 °C in annual mean temperature.

Nishinomiya City, on the ground in suburban areas in two cities in Hiroshima Prefecture, and on the ground in the National Institute of Infectious Diseases, Tokyo. While the numbers of *A. albopictus* mosquitoes collected by CDC miniature traps at most points were not high, a large number of mosquitoes were collected at one point in Tokyo (Figure 1). The results demonstrated that the population density of *A. albopictus* was considerably high and that there were marked differences in the population densities across areas, with discrepancies found between collection points even within a small public space or in different parts of a temple. This is likely related to the abundance of vegetation, as abundant vegetation harbors mosquitoes, and to the number of potential larval breeding habitats, including catch basins, located around the collection points.

3. Analysis of the recent distribution of *Aedes albopictus* with a focus on annual mean temperature by GIS in Japan

We previously reported that the annual mean temperature in Tohoku District of Honshu Island, Japan was clearly related to the distribution of *A. albopictus*.[5] However, the map used in the previous study was charted using old climate data, which were collected between 1971 and 2000. In this retrospective study, a map of 1-km mesh climate values was charted using data collected by the Japan Meteorological Agency in 2013. The annual mean temperature was above 12 °C in all five of the areas visited by the German patient (Figure 2). With the exception of higher altitude parts of the central mainland of Japan, the western parts of Tokyo were infested with *A. albopictus* and the population density was relatively high in comparison to northern Honshu.

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Conflict of interest: None declared.

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