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First report of an ambrosia beetle, *Platypus quercivorus*, vector of Japanese oak wilt, in Hokkaido, northern Japan

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ABSTRACT

An ambrosia beetle, *Platypus quercivorus*, is the vector of Japanese oak wilt, one of the most serious forest diseases in Japan. *P. quercivorus* is widely distributed in the main islands of Honshu, Kyushu and Shikoku, but there have been no records of *P. quercivorus* in Hokkaido, the northernmost main island in Japan. Because the mass mortality of oak trees caused by Japanese oak wilt is spreading northward in northern Honshu, we sampled *P. quercivorus* in 20 forest sites in the southernmost part of Hokkaido by using pheromone traps. Five *P. quercivorus* (two males and three females) were collected from four sites. Because oak species distributed in Hokkaido are all susceptible to Japanese oak wilt, monitoring and control measures will be needed to prevent the spread of Japanese oak wilt in Hokkaido.

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Ambrosia beetle; forest pest; Japanese oak wilt; pheromone trap; *Quercus crispula*

Introduction

An ambrosia beetle, *Platypus quercivorus* (Murayama), is the vector of Japanese oak wilt, one of the most serious forest diseases in Japan. This disease has been reported from many deciduous and evergreen oak species, and damage is especially severe in *Quercus crispula* in northern Japan (Kobayashi and Ueda 2005).

Platypus quercivorus is distributed in Japan, Taiwan, India, Indonesia and New Guinea (Wood and Bright 1992; Nobuchi 1993b). Thus, Japan is the northern edge of the distribution of this species. In Japan, *P. quercivorus* is widely distributed in the main islands of Honshu, Kyushu and Shikoku, as well as in the smaller islands of Sadogashima, Tsushima, Izu islands, Yakushima and Ryukyu islands (Kabe 1960; Nobuchi 1993a; Hamaguchi and Goto 2010; Ueda 2012). However, there have been no previous records of *P. quercivorus* in Hokkaido, the northernmost main island in Japan.

Massive mortality of oak trees caused by Japanese oak wilt has been occurring in Japan since the late 1980s (Ito and Yamada 1998). The disease has since expanded through most parts of Japan, and in 2019, damage was reported in 38 out of the 47 prefectures (Forest Agency 2019). In the Tohoku region, northern Honshu, damage is spreading northward, and in 2019, damaged area was suddenly increased in Aomori prefecture, the northernmost prefecture in Honshu (Forest Agency 2019). Because the nearest distance between Honshu and Hokkaido is about 20 km, migration of *P. quercivorus* to Hokkaido is highly concerned. In this study, we set pheromone traps in the southernmost part of Hokkaido, and collected a few *P. quercivorus* adults.

Material and methods

We conducted this study in 2020 in Matsumae, Fukushima and Shiriuchi town. These three towns are located in the southernmost part of Hokkaido. We set pheromone traps within 30 km from Cape Shiragami (N41° 24–35′, E140° 01–25′), which is the southern edge of Hokkaido island (Figure 1).

Beetle sampling was conducted in 20 sites (Table 1), which were chosen in forests with a cluster of *Q. crispula* trees with an average diameter at breast height >20 cm. Other than *Q. crispula*, these forests were dominated by *Acer pictum*, *Cryptomeria japonica* and *Tilia japonica*. The 20 sites were located within 5 km from the coast and were at least 700 m apart from one another.

We collected beetles using collision traps (Sankei Chemical Co., Ltd., Kagoshima, Japan), which are transparent in colour with two cross barriers (30 cm in width × 20 cm in height) and a water basin (23 cm in diameter). Water basins were filled with 500 ml propylene glycol as preservative. Each trap was baited with a synthetic aggregation pheromone (Kashinagakoru-L® manufactured by Sankei Chemical Co., Ltd., Kagoshima, Japan). From this lure, 10 mg of 78% quercivorol, which is the main component of aggregation pheromone of *P. quercivorus* (Tokoro et al. 2007), is evaporated every day for 6 weeks. 50 ml of 50% ethanol was also set as a co-attractant (Saito et al. 2008).

We deployed one trap in each site from 6–7 July to 5–7 August, which coincided with the adult flying season of *P. quercivorus*. When we set and removed the traps, we also looked for oak dieback caused by Japanese oak wilt. Beetles collected in the traps were brought to the laboratory for identification, and examined whether *P. quercivorus* were collected using Nobuchi (1973). Voucher specimens from this study were deposited at Hokkaido Research Center, Forestry and Forest Products Research Institute.

Results and discussion

A total of five beetles (two males and three females) belonging to the subfamily Platypodinae were collected from four sites. We identified these beetles as *P. quercivorus* because female pronotum had seven or eight large fovea, and male

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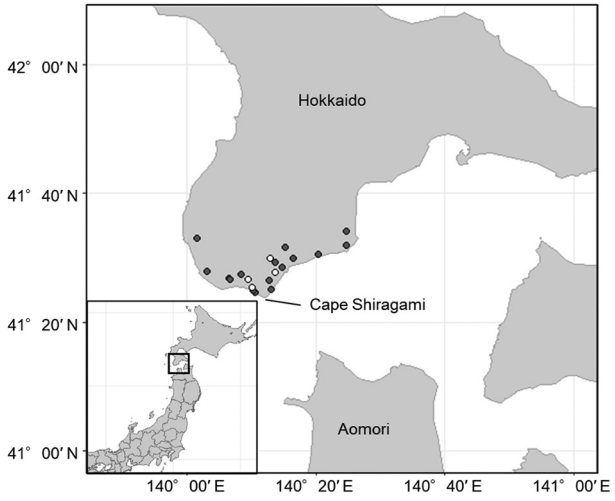

Figure 1. Maps of southern Hokkaido and northern Honshu (Aomori prefecture). Circles indicate beetle sampling sites and open circles indicate where *Platypus quercivorus* were collected.

elytron had a long spine at summit followed by a short spine with teeth on declivital region. We also compared these beetles to morphologically similar *Platypus koryoensis* (Murayama), the recently recorded Platypodinae species in Kyushu, Japan (Ueda and Goto 2017). In *P. koryoensis*, area surrounding fovea on female pronotum was darker with more pits, and declivital region of male elytron had three distinct spines (Hong et al. 2006); therefore, these five beetles collected were not identified as *P. koryoensis*.

Each of one *P. quercivorus* was collected from site Nos. 9, 14 and 15, which were located 1–2 km from the coast (Table 1). In contrast, two female *P. quercivorus* were collected from site No.7, which was one of the most inland sites (5 km from the coast) among the 20 sites. No wilting *Q. crispula* trees were found during this study.

Because this is the first survey of *P. quercivorus* using pheromone traps in Hokkaido, the period when the beetle population invaded from Honshu remains unknown. There is also a possibility that *P. quercivorus* is indigenous to Hokkaido, but was not found in previous surveys that did not use pheromone traps.

Hamaguchi and Goto (2010) compared D1–D2 region of nuclear 28S rDNA among *P. quercivorus* populations in Japan, and found two distinct groups: group A and group B. Group A was distributed across a wide range in Japan, while group B was detected only from the southern part of Japan. They suggested that these two groups are expected to differ in morphology. Group A and B also differ in response to the aggregation pheromone: quercivorol only attracts adults of group A (Tokoro et al. 2013). This finding and the geographical distribution of two groups suggest that *P. quercivorus* collected in the present study belong to group A of Hamaguchi and Goto (2010).

Three deciduous oak species (*Q. crispula, Quercus serrata* and *Quercus dentata*) are distributed in Hokkaido. All of these species are susceptible to Japanese oak wilt (Murata et al. 2005, 2020). Particularly, *Q. crispula* is the most suitable host species for *P. quercivorus* because *Q. crispula* causes severe mortality after beetle attack, and *P. quercivorus* can achieve higher reproductive success in *Q. crispula* than in other oak species (Kamata et al. 2002). In spite of the fact, *Q. crispula* is the most common oak species in Hokkaido, and provides large amounts of acorns, which are an important food resource for forest-dwelling animals. *Q. crispula* is also a commercially important species, and large-diameter trees, which are susceptible to Japanese oak wilt, are used as high-quality timber. Thus, forestry and forest ecosystem will suffer enormous damage if Japanese oak wilt spreads through Hokkaido. Therefore, monitoring of *P. quercivorus* population and oak wilt damage is needed to prepare for effective control measures that will prevent the spread of Japanese oak wilt in Hokkaido.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Table 1. Beetle sampling site and the number of *Platypus quercivorus* collected.

Site No	Latitude	Longitude	Forest type	Forest age	*P. quercivorus*
1	N41° 34.1′	E140° 24.7′	Natural	81	
2	N41° 32.0′	E140° 24.7′	Cedar plantation	65	
3	N41° 30.6′	E140° 20.3′	Natural	76	
4	N41° 30.0′	E140° 16.5′	Natural	98	
5	N41° 31.6′	E140° 15.2′	Natural	98	
6	N41° 29.4′	E140° 13.6′	Cedar Plantation	72	
7	N41° 30.0′	E140° 12.8′	Natural	130	2♀
8	N41° 28.6′	E140° 14.7′	Natural	76	
9	N41° 27.8′	E140° 13.7′	Unknown	Unknown	1♀
10	N41° 26.6′	E140° 12.7′	Natural	71	
11	N41° 25.2′	E140° 13.1′	Natural	109	
12	N41° 24.7′	E140° 10.6′	Unknown	Unknown	
13	N41° 25.0′	E140° 10.2′	Unknown	Unknown	
14	N41° 25.5′	E140° 10.0′	Natural	76	1♂
15	N41° 26.7′	E140° 09.5′	Natural	81	1♂
16	N41° 27.4′	E140° 08.3′	Natural	130	
17	N41° 26.9′	E140° 06.5′	Natural	81	
18	N41° 26.7′	E140° 06.6′	Cedar plantation	67	
19	N41° 27.9′	E140° 03.0′	Unknown	Unknown	
20	N41° 33.0′	E140° 01.5′	Natural	130	

Forest type and forest age are from forest resource database of Hokkaido prefectural government. Forest Resource Database (2020).

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