

## Fossil Insects from the Pleistocene Kobiwako Group at Taga Town, Shiga Prefecture, Japan

Katsuro YAHIRO<sup>1)</sup> and Masakazu HAYASHI<sup>2)</sup>

<sup>1)</sup>Lake Biwa Museum, 1091 Oroshimo, Kusatsu, Shiga, 525–0001 Japan

<sup>2)</sup>Hoshizaki Green Foundation, 1664–2 Sono, Izumo, Shimane, 691–0076 Japan

**Abstract** Fossil insects were obtained from the Pleistocene Kobiwako Group of Taga Town, Shiga Prefecture, Japan. The fossil assemblage consists of Carabidae, Elateridae, Chrysomelidae, and Curculionidae. Carabidae, Elateridae, and Curculionidae were recorded from the Kobiwako Group for the first time. *Donacia* (*Donaciomima*) sp. cf. *versicolorea* (BRAHM, 1790) was the most abundant. The ecology of extant populations of this species basically suggests an aquatic setting for these fossils, and we assume that dead remains of *D. (D.)* sp. cf. *versicolorea* accumulated in the stable bodies of water inhabited their host plants, with no need to invoke exogenous transport. Wetland circumstances are also suggested by the known ecology of the genus *Bembidion* (Carabidae).

### Introduction

A geological survey of the Kobiwako Group was conducted in 1993 in the district of Shide, Taga Town, Inukami County, Shiga Prefecture, considering the construction of the Biwa-ko Lake East Core Industrial Park (TAMURA *et al.*, 1993). Elephant fossils (KONISHI & OTODA, 1994), deer fossils (ABE *et al.*, 1994), plant macrofossils (YAMAKAWA, 1994), and molluskan fossils (TAMURA *et al.*, 1994) were found. As a follow-up work, the Taga Town Ancient Elephant Excavation Project was instituted in 2013, in cooperation with the Shiga mining operations of the Sumitomo Osaka Cement Corporation.

Fossil insects from the Kobiwako Group have poorly been known (TOMINAGA & Insect Fossil Research Group, 1993; MORI, 1996; HAYASHI & SHIYAKE, 2002; HAYASHI, 2006), and there has been no report on insect fossils from the deposits at Shide except that by YAHIRO and HAYASHI (2014) concerning insects from the first excavation in 2013. In the second excavation of 2014 the same fossil donaciine beetles were obtained again. The present report covers the third excavation carried out from March 14 to April 12 2015.

### Geological Setting

The Kusatsu and Gamo Formations, which comprise the middle part of the Kobiwako Group, are distributed around the investigation area, and seven volcanic ash beds (Shide river I, Shide river II, Shide, South Shide river, Tominoo, MP, and Nashinoki) have been described as key beds in the area. The Shide volcanic ash bed is correlated to the widespread Kd44-Nk tephra, and is approximately 1.9Ma (SATOGUCHI & NAGAHASHI, 2012).

The fossil locality is at Shide, Taga Town, Shiga Prefecture (Fig. 1). The geological column of the site is diagrammed in Fig. 2. The Shide Member is the uppermost part of the Gamo Formation and is mainly composed of massive mud, organic mud, massive mud and sandy mud, organic sandy mud, tuffaceous sand, and tuffaceous sandy mud. The insect fossils reported here were recovered from tuffaceous sandy mud with plant fossils and obtained from grids 7, 8, 12, 13, 14 at the site.

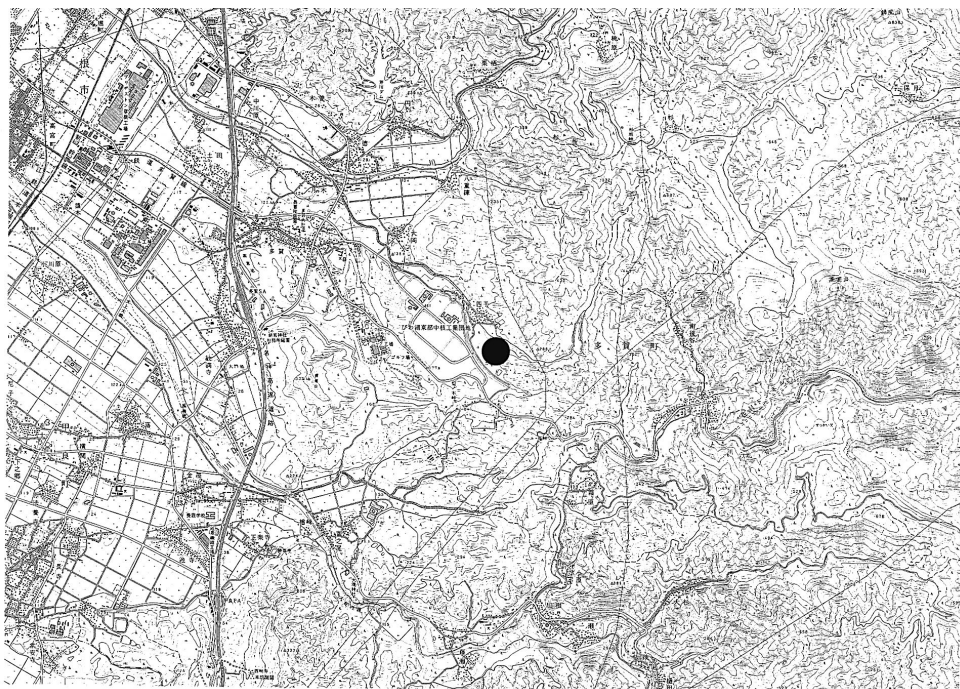


Fig. 1. Map showing the excavated locality for fossil insects at Shide District, Taga Town. (Topographic map "Takamiya", scale 1:25,000. issued by Geographic Survey Institute.)

## Methods and Materials

The tuffaceous sandy mud bed of the formation is weakly cemented. All fossil specimens were found by splitting rocks with an eyeleteer and examining the exposed surfaces. Deposits with fossils were preserved in closed cases, immersed in ethyl alcohol. Most specimens were examined, and photographs were taken under a stereoscopic microscope. All fossil specimens reported in this paper are deposited in the Lake Biwa Museum (LBM).

## Results

An assemblage of 100 fossil insects was obtained, all belonging to Coleoptera. The assemblage consists of Carabidae, Elateridae, Chrysomelidae, and Curculionidae (Table 1). *Donacia* (*Donaciomi-**ma*) sp. cf. *versicolore*a was the most abundant species. Fourteen of the fossils could not be identified to any family.

## Description of Fossils

### COLEOPTERA

#### Family Carabidae

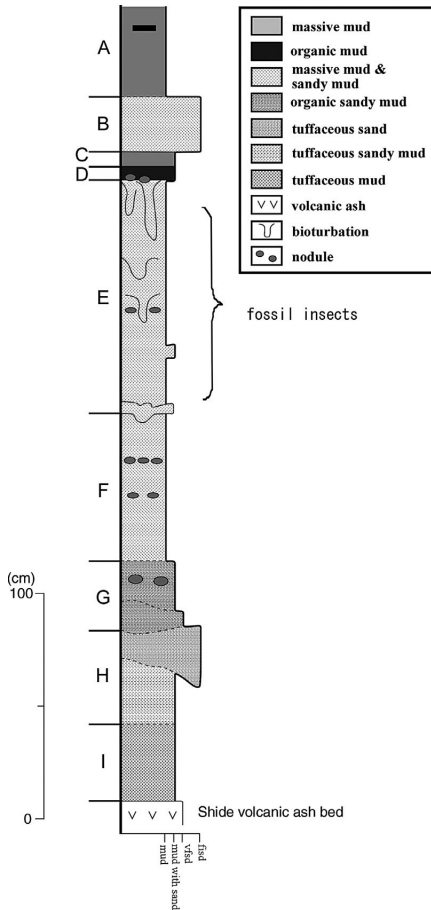


Fig. 2. The geological column of the Shide Member at the locality of insect fossils reported herein. (original drawing by Y. SATOGUCHI.)

***Bembidion* sp.**

(Fig. 3A)

*Description.* Elytron black, weakly metallic green; striae clear; striae intervals smooth; dorsal pore on 3rd striae interval; elliptical patch on apical part.

*Measurements.* Elytron, length 0.9 mm; width, 1.8 mm.

***Chlaenius* sp.**

(Fig. 3B)

*Description.* Elytron black, matte; striae clear; striae intervals densely punctate.

*Measurements.* Elytron, length 3.1 mm, width 1.5 mm.

Family **Elateridae**

**Elateridae** sp. 1

(Fig. 3C)

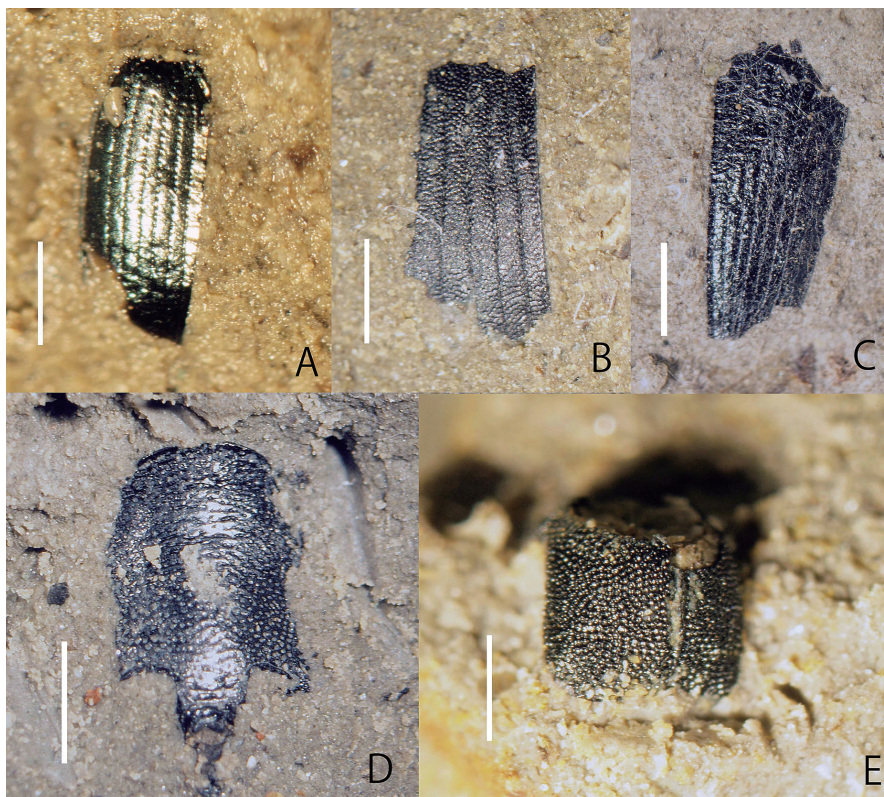


Fig. 3. Fossil insects recovered from the Shide Member. — A, *Bembidion* sp., elytron; B, *Chlaenius* sp., elytron; C, Elateridae sp., elytron; D, Elateridae sp., prosternum; E, Curculionidae sp., pronotum. Scale bars: 1.0 mm.

*Description.* Partial elytron lacking basal and apical areas. Elytron metallic black; with nine strial punctures, intervals shiny but rugose, with fine punctation.

*Measurements.* Elytron, length 4.5 mm, width 2.0 mm.

#### **Elateridae sp. 2**

(Fig. 3D)

*Description.* Prosternum metallic black; elongate, with a process on base; coarsely punctate.

*Measurements.* Prosternum, length 4.2 mm.

#### **Family Curculionidae**

##### **Curculionidae sp.**

(Fig. 3E)

*Description.* Pronotum metallic black; entirely cylindrical; median line present, densely and coarsely punctate.

*Measurements.* Pronotum, length 1.0 mm, length 1.5 mm.

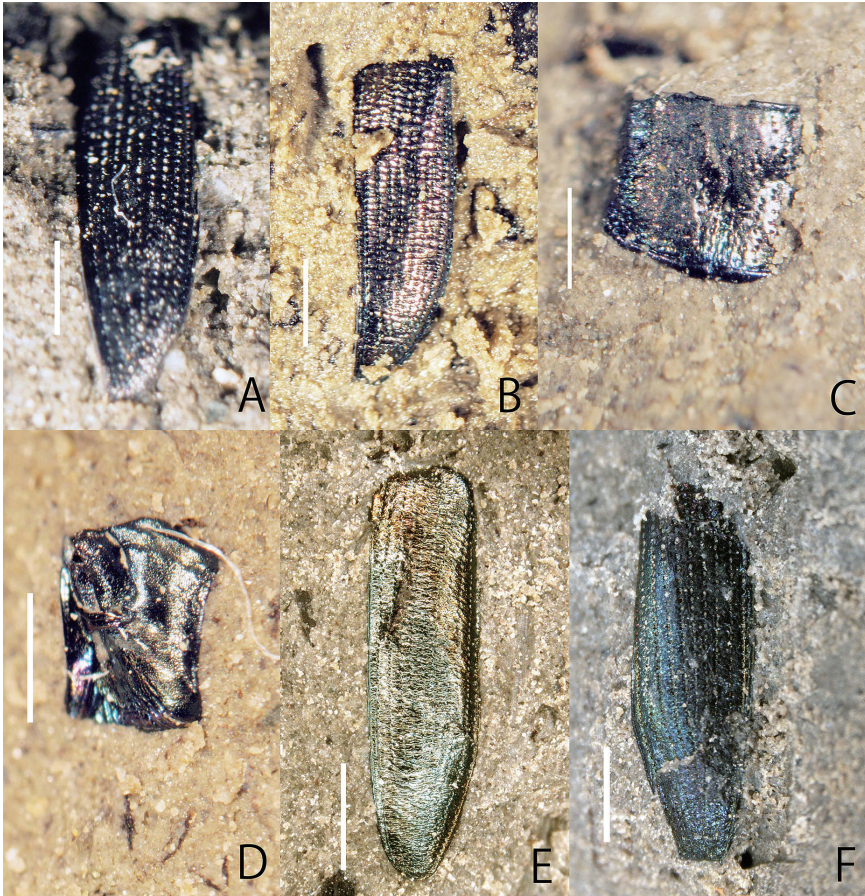


Fig. 4. More fossil insects recovered from the Shide Member. — A–B, *Donacia* cf. *versicolorea*, elytra; C–D, *Donacia* cf. *versicolorea*, pronota; E, *Donacia* sp. 1, elytron; F, *Donacia* sp. 2, elytron. Scale bar: 1.0 mm.

#### Family Chrysomelidae

##### *Donacia* (*Donaciomima*) cf. *versicolorea*

(Fig. 4A–D)

*Description.* Pronotum entirely metallic blue or green, partly coppery; elytron entirely coppery but outer intervals (10th and 11th) and apical area metallic blue or purple. Pronotal outline more or less quadrate; median line fine; anterolateral calli indistinct; disc entirely shiny, scattered punctate, but lateral part rugose; basal sulcus shallow. Elytron sub-parallel sided from base to middle and gradually narrowed toward apex; with ten complete punctate striae and a scuteller striole; strial punctures nearly vertical oval; all intervals shiny; sutural intervals gradually narrowing to apex, and smooth without rugosity; 2nd to 9th intervals smooth, more or less rugose; 10th and 11th intervals rugose; apex truncate, outer apical angle obtuse, inner apical angle right.

*Measurements.* Pronotum, length 1.0–1.2 mm; elytron, length 3.3–4.5 mm, width 1.2–1.3 mm.

Table. 1. Fossil insects recovered from the Shide Member.

Taxa / Grids	G7	G8	G12	G13	G14	Y-02 <sup>1)</sup>	
COLEOPTERA							
Carabidae							
<i>Bembidion</i> sp.				1			1
<i>Chlaenius</i> sp.				1			1
Elateridae							
Elateridae sp.			1	1			2
Chrysomelidae							
<i>Donacia (Donaciomima)</i> sp. cf. <i>versicolorea</i>	7	3	5	16	7		38
<i>Donacia (Donaciomima)</i> sp. 1					1		1
<i>Donacia (Donaciomima)</i> sp. 2				1			1
<i>Donacia</i> sp.			3	1			4
Donaciinae sp.	14		4	4	14		36
Chrysomelidae sp.?				1			1
Curculionidae							
Curculionidae sp.				1			1
Other Coleoptera	5		4	1	2		12
Other Insecta				1		1	2
total	26	3	17	29	24	1	100

<sup>1)</sup> The original grid for this sample is unclear.

***Donacia (Donaciomima)* sp. 1**

(Fig. 4E)

*Description.* Partial elytron lacking basal area; entirely metallic dark blue without longitudinal stripe in middle. Elytron lacking basal area; gradually narrowing toward apex; with ten complete punctate striae; stria punctures vertical oval; all intervals finely rugose; apex narrowly truncate, outer and inner apical angles nearly right.

*Measurements.* Elytron, length 4.2 mm, width 1.5 mm.

***Donacia (Donaciomima)* sp. 2**

(Fig. 4F)

*Description.* Elytron entirely metallic green; sub-parallel sided from base to middle and gradually narrowed toward apex; with ten complete punctate striae and a scuteller striole; stria punctures vertical oval; all intervals rugose; sutural intervals gradually narrowing to apex, and rugose; apex more or less rounded, outer apical angle obtuse, inner apical angle right.

*Measurements.* Elytron, length 4.7 mm, width 1.2 mm.

**Discussion**

*Bembidion* sp. (Carabidae), *Chlaenius* sp. (Carabidae), Elateridae, and Curculionidae were recorded from the Kobiwako Group for the first time. *Donacia (Donaciomima)* sp. cf. *versicolorea* was the most abundant taxon. Its presence suggests an aquatic habitat with water areas where float-

ing-leaved plants (see YAHIRO & HAYASHI, 2014). Because the number of individuals was high in all three excavations carried out at this site, these insects seem to have accumulated in the stagnant water at the site, rather than having been carried in from an immediate locality. Two additional species, *Donacia* (*Donaciomina*) sp. 1 and sp. 2, can be distinguished clearly and three species of this genus were present. The latter two species were very few, thus might have been transported from a neighboring area or the emergent plant community. Wetland circumstances are also suggested by the known ecology of the carabid genus *Bembidion*.

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### 要 約

八尋克郎・林 成多：滋賀県多賀町の古琵琶湖層群から産出した昆虫化石（鞘翅目）。—— オサムシ科のミズギワゴミムシ属およびアオゴミムシ属、コメツキムシ科、ゾウムシ科は、古琵琶湖層群から初めて確認された。アオヘリネクイハムシに比較される種が38点産出している。現生のアオヘリネクイハムシの生態から、浮葉植物が生えるような水域があったことが推測される。また、第一次、第二次、第三次発掘調査を通して、アオヘリネクイハムシに比較される種の産出数が多いことから、ある程度は基本的に安定した止水域で堆積したもので、外部からの異地性の昆虫遺骸が運搬されてくるような状況ではなかったものと推測される。フトネクイハムシ亜属の一種(1)、フトネクイハムシ亜属の一種(2)の2種はいずれもアオヘリネクイハムシ近似種とは明確に区別できるので、3種いたことは間違いない。産出数は非常に少ないので、離れた場所に湿性植物群落や抽水植物群落があって、そこから遺骸が流されてきたのかもしれない。オサムシ科のミズギワゴミムシ属の現生の生態から、水域の周辺に湿地が広がっていた可能性がある。

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