Chironomids (Diptera, Chironomidae) of the Franz Josef Land archipelago (Arctic Russia)

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The first data on the chironomids fauna of the Franz Josef Land archipelago belong to M. Goetghebuer (1933). He noted 16 adults males *Hydrobaenus conformis* (Holmgren, 1869). In the present study, three new species (*Diamesa* (*Diamesa*) *arctica* (Boheman, 1865), *Limnophyes pumilio* (Holmgren, 1869), *Tokunagaia rectangularis* (Goetghebuer, 1940)) and one new subfamily (Diamesinae) are recorded in the Franz Josef Land archipelago bringing the chironomid fauna in this archipelago to a total of seven species from two subfamilies.

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INTRODUCTION

The Franz Josef Land archipelago is a compact group of 192 islands, which are located in the northern part of the Barents Sea on the edge of the continental shelf some 800 km from the nearest mainland, the north-west Taimyr Peninsula, Siberia. The archipelago has a relatively small span: from west to east – 375 km, from north to south – 234 km. It is the most glaciated area within Eurasian Arctic with 85% of the area covered by ice (Grosswald et al. 1973). The archipelago lies within the Atlantic region of the Arctic climatic zone, its climate is typically maritime. The average annual temperature is -11.0 to -12.0°C. Summer is short and cool with average monthly temperatures exceeding zero (+0.2 to +1.1°C) observed in July and August. Sub-zero temperatures can occur throughout the year. High winds (over 15 ms^{-1}) are recorded for 56 to 84 days a year (Vassiliev 2013). Summer seasons of the study years were relatively warm with mid-summer air temperatures averaged within +0.9 to +1.3°C, peaked at 4 to 5°C in July-August (data of the Krenkel weather station on Hayes Island, http://www.rp5.ru).

The vegetation of Franz Josef Land refers to a polar desert type (Alexandrova 1983) with cryptogam, herb barrens and grass, forb, cryptogam tundra complexes defined (CAVM 2003). Plant cover is sparse (less than 40%) and very low-growing in dry and wet barrens with few vascular plant species among bryophytes and cryptogamic crusts, or moderate (40–80%, in some favorable places up to 100%) in moist habitats where more diverse grasses, forbs, lichens and mosses are common and more developed.

Remote high-Arctic areas are difficult to access and knowledge of their biodiversity is rather incomplete, mostly in terms of easily recordable species such as birds, mammals, or vascular plants. Terrestrial invertebrates are often overseen even in more detailed studies in spite of their importance for land ecosystems functioning. Among other Arctic islands, the Franz Josef Land has an extreme lack of knowledge on terrestrial invertebrate fauna diversity (Coulson et al. 2014). Conservation status of the archipelago, which is designated as a special purpose reserve since 1994, puts collection of the biodiversity data on different taxa as a priority task.

Table 1. List of stations giving locality data where chironomids species were found during this study.

Date	Station	Locality	Latitude and longitude
17.VIII.2012	1	Alger Island, Cape Podgornyi	N 80°22'54,66" E 55°46'12,79"
14.VIII.2013	2	Alger Island, Cape Podgornyi	N 80°22'55,2" E 55°46'11,2"
21.VIII.2013	3	Bell Island, Nielsen Bay	N 80°02'11,6" E 49°12'57,2"
12.VIII.2012	4	George Land, Krauter Cape	N 80°10'2,93" E 47°13'27,23"
13.VIII.2012	5	George Land, south coast between Niel and Krauter capes	N 80°15'7,92" E 46°54'22,90"
9.VIII.2012	6	Hayes Island, nearby Krenkel weather station	N 80°37'51,67" E 58°7'41,23"
3–7.VIII.2012	7	Hooker Island, Tikhaya Bay	N 80°20'15,94" E 52°45'54,29"
4.VIII.2013	8	Hooker Island, Tikhaya Bay	N 80°20'10,3" E 52°46'32,9"
2.VIII.2013	9	Hooker Island, Rubini Rock	N 80°19'2,7" E 52°51'4,5"
22.VIII.2012	10	Mabel Island, Konrad Cape	N 80°01'38,35" E 49°20'2,15"
21.VIII.2013	11	Mabel Island, Konrad Cape	N 80°01'9,4" E 49°21'28,5"
5.VIII.2012	12	Ziegler Island, Meshok Bay	N 81°04'0,73" E 56°17'41,89"

The first data on the chironomid fauna of the Franz Josef Land archipelago were presented by M. Goetghebuer (1933). He noted 16 adults males of *Hydrobaenus conformis* (Holmgren, 1869), which were collected on August 17, 1930 on the Bell Island. Further investigations were continued by A.B. Krasheninnikov and M.V. Gavrilo (2012) almost eighty years later.

This study focuses on non-biting midges, family Chironomidae, which is known to be one of the most species rich and abundant groups of amphibiotic arthropods at high latitudes. New data on distribution of chironomids contributes to our knowledge on global biodiversity patterns and is important for better understanding of their evolution and adaptations to different environmental conditions.

MATERIAL AND METHODS

The material for this study was collected during August of 2012 and 2013 at 12 sites in the Franz Josef Land archipelago (Table 1). Chironomids were either sampled manually from the vegetation and water surface of small ponds (in 2012), or by means of sweep nets from developed vegetation patches (in 2013). All insects were collected in warm weather with air temperatures of +4 – +6°C (our local measurements) and mostly during calm days. The material was preserved in Oudemans' solution and later mounted on slides in sandarac medium (Krasheninnikov 2011). Specimens are deposited in the collections of the Perm' State University, Chironomids collection (Diptera, Nematocera, Chironomidae) of Krasheninnikov Andrey Borisovitch (CCK).

The publications of Halvorsen and Sæther (1987), Lundström (1915), Makarchenko (1998), Makarchenko and Makarchenko (2007, 2009), Sæther (1976, 1989, 1990, 1995 and 2004) were used for identification of collected chironomids.

RESULTS

The following is an annotated list of species that have been found by us on the archipelago.

Subfamily Diamesinae

Diamesa (Diamesa) arctica (Boheman, 1865)

Material examined: CCK 149/1, 1 male imago, station number (stn) 11.
Distribution: Holarctic arctic-alpine species (Makarchenko 1998).
Remarks: It is a new species to the archipelago.

Subfamily Orthocladiinae

Chaetocladius (Amblycladius) franzjosephiensis Krasheninnikov, 2013

Material examined: CCK 146/1, 1 male imago, stn 1.
Distribution: The species is known only from the type locality from Cape Podgornyi, Alger Island, the Franz Josef Land archipelago.
Remarks: A species is closely related to *Ch*. (*A*.) *subplumosus* (Kieffer, 1923) and *Arctosmittia biserovi* Zelentzov, 2006. It can be easily distinguished from the first species by megaseta and well developed IVo, from the second species by well-developed anal point.

Hydrobaenus conformis (Holmgren, 1869)

Material examined: CCK 148/8, 1 male imago, stn 3, CCK 148/4, 148/5, 2 male imago, stn 10, CCK 148/9, 1 male imago,

stn 11, CCK 148/1, 148/2, 148/6, 148/7, 4 male imago, stn 12.
Distribution: Holarctic species: Algeria, Canada, Finland, France, Japan, Lebanon, Norway, Russia (Franz Josef Land archipelago, Urals, Baikal, Far East), Sweden (Ashe, O'Connor 2012; Krasheninnikov 2013).

Limnophyes pumilio (Holmgren, 1869)

Material examined: CCK 83/1, 1 male imago, stn 8.
Distribution: Holarctic species: Austria, Canada, Denmark, Finland, France, Germany, Great Britain, Greenland, Ireland, Lebanon, Netherland, Norway, Romania, Russia, Sweden, Switzerland, U.S.A. (Ashe, O'Connor 2012; Krasheninnikov 2013).
Remarks: It is a new species to the archipelago.

Metriocnemus (Metriocnemus) eurynotus (Holmgren, 1883)

Material examined: CCK 90/6, 1 male imago, stn 2, CCK 90/1, 90/2, 90/3, 3 male imago, stn 4, CCK 90/4, 1 male imago, stn 5, CCK 90/5, 1 male imago, stn 7, CCK 90/7, 1 male imago, stn 8, CCK 90/8, 1 male imago, stn 9.
Distribution: Holarctic species: Austria, Belgium, Canada, China, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Greenland, Hungary, Iceland, Ireland, Italy, Japan, Lebanon, Morocco, Netherland, Norway, Poland, Portugal, Romania, Russia, Slovakia, Spain, Sweden, Switzerland, U.S.A. (Ashe, O'Connor 2012; Krasheninnikov 2013).

Metriocnemus (Metriocnemus) sibiricus (Lundström, 1915)

Material examined: CCK 147/4, 1 male imago, stn 5, CCK 147/1, 147/2, 147/3, 3 male imago, stn 6, CCK 147/5, 1 male imago, stn 9.
Distribution: The New Siberian Islands, Franz Josef Land archipelago (Krasheninnikov, Gavrilo 2013).
Remarks: All detected specimens are females. Currently, males of this species have not been found in Franz Josef Land.

Tokunagaia rectangularis (Goetghebuer, 1940)

Material examined: CCK 136/1, 1 male imago, stn 2.
Distribution: This is a transpalaearctic species: Austria, China, Finland, France, Italy, Mongolia, Norway, Romania, Russia (Urals, Far East), Sweden, Switzerland, Turkey (Ashe, O'Connor 2012; Krasheninnikov 2013).
Remarks: It is a new species to the archipelago. Hypopygium of this specimen is shown in Figure 1.

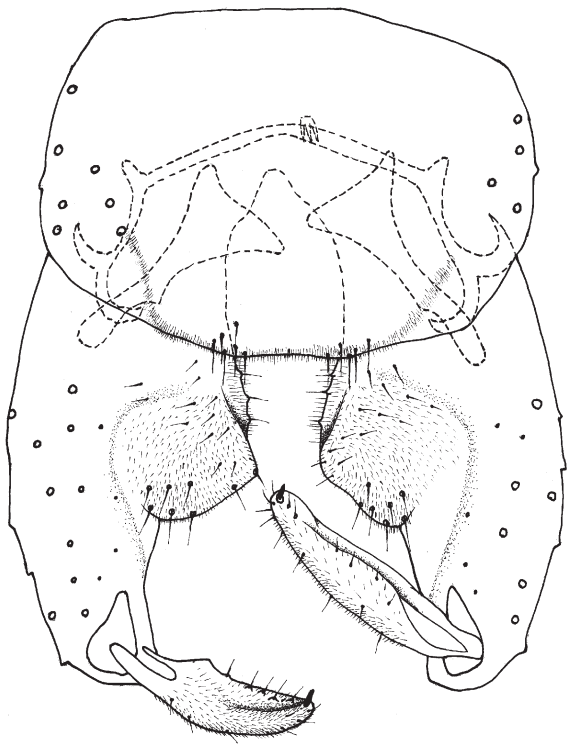

Figure 1. Hypopygium of *Tokunagaia rectangularis* (Goetghebuer, 1940) from the Alger Island.

DISCUSSION

From the present results the chironomid fauna of the Franz Josef Land archipelago now include a total of seven species from six genera belonging to two subfamilies (Diamesinae and Orthocladiinae). The three species *Diamesa* (*Diamesa*) *arctica, Limnophyes pumilio* and *Tokunagaia rectangularis* were observed in the study area for the first time. It should be emphasized that chironomids are the only amphibiotic insects from the archipelago known so far. The total number of chironomids is low as compare to the better studied Arctic archipelagos such as Svalbard and Novaya Zemlya, where 63 and 68 species are revealed respectively (Krasheninnikov 2013; Coulson et al. 2014). This reflects a poor state of knowledge but also more severe environmental condition in Franz Josef Land.

Most of the found species are widespread with four species having a Holarctic distribution and one species (*Tokunagaia rectangularis*) has a transpalaearctic range. The other two species of non-biting midges, *Ch.* (*A.*) *franzjosephiensis* and *M.* (*M.*) *sibiricus*, have insular high-Arctic range, with the former being endemic to the Franz Josef Land archipelago.

As for the distribution of other chironomid species on the islands of the Eurasian sector of the Arctic Ocean (Table 2), the *D.* (*D.*) *arctica* and *L. pumilio* are known from the Svalbard, the Novaya Zemlya archipelago and the Wrangel Island; *M.* (*M.*) *eurynotus* is found on the Svalbard, the Severnaya Zemlya

archipelago, the Novaya Zemlya archipelago and the Wrangel Island; *H. conformis* is recorded on the Svalbard and the Novaya Zemlya archipelago; *M.* (*M.*) *sibiricus* was described from the New Siberian Islands only before this study; *T. rectangularis* is known from the Wrangel Island (Hirvenoja 1967; Makarchenko, Makarchenko, Vekhov 1998; Makarchenko, Makarchenko 2001; Sæther 2004; Zelentsov 2007).

Occurrence of chironomids within the Franz Josef Land archipelago is also unevenly studied due to poor sampling (opportunistic collection only, and late in the season).

Table 2. The distribution of chironomid species found on the Franz Josef Land archipelago and on the islands of the Eurasian sector of the Arctic Ocean (Krasheninnikov 2013; Coulson et al. 2014).

Islands Species	Franz Josef Land	Svalbard	Novaya Zemlya	Severnaya Zemlya	New Siberian Islands	Wrangel Island
Diamesa (*Diamesa*) *arctica* (Boheman, 1865)	+	+	+	-	-	+
Chaetocladius (*Amblycladius*) *franzjosephiensis* Krasheninnikov, 2013	+	-	-	-	-	-
Hydrobaenus conformis (Holmgren, 1869)	+	+	+	-	-	-
Limnophyes pumilio (Holmgren, 1869)	+	+	+	-	-	+
Metriocnemus (*Metriocnemus*) *eurynotus* (Holmgren, 1883)	+	+	+	+	-	+
Metriocnemus (*Metriocnemus*) *sibiricus* (Lundström, 1915)	+	-	-	-	+	-
Tokunagaia rectangularis (Goetghebuer, 1940)	+	-	-	-	-	+

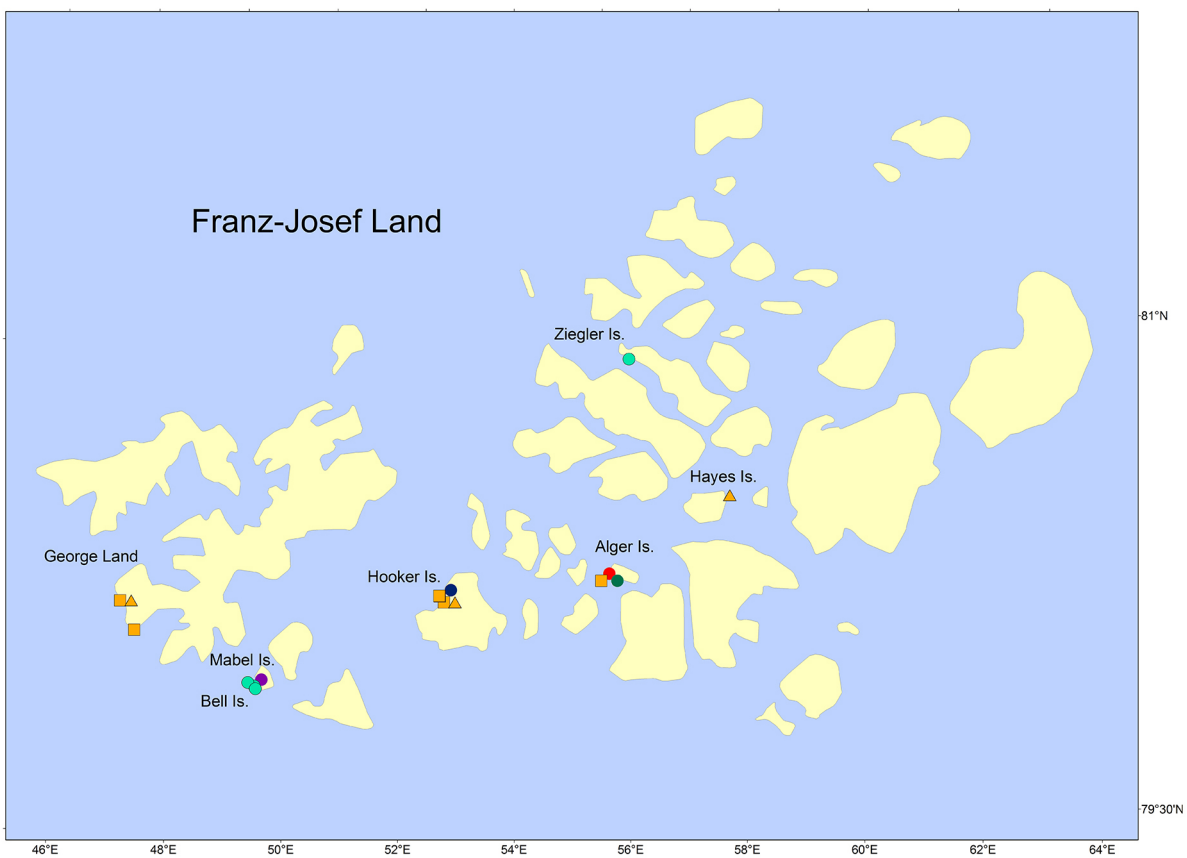

Figure 2. Distribution of chironomids on the Franz Josef Land archipelago: ● – *Diamesa* (*Diamesa*) *arctica;* ● – *Chaetocladius* (*Amblycladius*) *franzjosephiensis;* ● – *Limnophyes pumilio;* ■ – *Metriocnemus* (*Metriocnemus*) *eurynotus;* ▲ – *Metriocnemus* (*Metriocnemus*) *sibiricus;* ● – *Hydrobaenus conformis;* ● – *Tokunagaia rectangularis.* (The map was compiled on the basis of map sheets U-37,38,39,40 and U-41,42,43,44, which are made Minsk cartographic factory of Main Department of Geodesy and Cartography of the USSR Ministry of Internal Affairs and are printed in 1959).

There are three species known from the Alger and Hooker islands, two species from the Mabel Island and the George Land, and one species from the Bell, Hayes and Ziegler islands. Localities in the different Islands are shown in Figure 2.

While three species on Hooker Island were collected during two seasons in three different locations/stations with similar habitats (patchy grass-moss moist tundra on the low marine terrace), the two species on Alger Island were collected in the same location with waterlog grass-moss cover during two consecutive years (two stations in table 1). According to current state of knowledge, *H. conformis* is the most widespread and common species of non-biting midges on the Franz Josef Land. In two cases, mass occurences of this species was observed under conditions of air temperature at +4°C, no winds, prior to rain with a thunder (Ziegler Island, 2012) or under dense fog (at Bell Island in 2013). Chironomids flocked on attractive surfaces like wooden walls of buildings, white stones, bright cloths etc. up to the observed height of 2 m.

Information on species composition and distribution of chironomids obtained in this study contributes not only to knowledge of the Franz Josef Land biodiversity but also to better understanding of chironomid diversity and distribution through the circumpolar range, it gives background information for further monitoring of insect diversity and species distribution, and possible invasions in high-Arctic under conditions of current climate change.

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