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Taxonomic Study of Black Flies in Hokkaido, with Notes on their Veterinary Viewpoint (Diptera : Simuliidae)

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Abstract

In this paper, the author deals with the taxonomic study of black flies in Hokkaido, chiefly based upon materials collected during the past 10 years. Furthermore, some biological notes are given in relation to veterinary medicine. The results are summarized below.

1. Thirty one species of black flies were recorded from Hokkaido. Among these, *Twinnia subtibbelesi* et al., 14 species were described as new species, and *Boophthora yonagoense makunbei* was described as new subspecies.

2. Subfamily Cnephiinae was established as new subfamily, and tribe Helodoini was established as new tribe.

3. *Helodon multicaulis* and *Montisimulium sakhalinum* were recorded for the first time from Japan, and *Gnus daisense* and *Gomphostilbia shogakii* were recorded for the first time from Hokkaido by the author.

4. Biting and annoying species of veterinary impotance have a wide range of feeding preference for domestic animals—horses, cattle, goats and chickens (cf. Table V.). Species were reported as follows :
Prosimulium jezonicum, *P. yezoense*, *Odagmia aokii*, *Simulium japonicum*, *S. nikkoense*, *S. suzukii*, *S. rufibasis* and *Gnus daisense*. Especially *S. japonicum* is a severely annoying species for horses and cattle in the meadows and pastures.

5. Females of *Gnus daisense* attacked goats, but they were not observed attacking humans, cattle and horses.

6. Females of *Twinnia canivora* and *Stegopterna nukabirana* rarely bite man, but they are very annoying species at high altitudes. They are presumably orinithophlic.

7. Human biting species were observed as follows :
Prosimulium jezonicum, *Odagmia aokii* and *O. nishijimai* in late Spring ; *Prosimulium yezoense*, *P. karibaense*, *P. apoinum* and *S. japonicum* in early Summer, especially *S. japonicum* is a severely aggressive species ; *S. arakawae*, *S. horokaense*, *S. suzukii* and *S. rufibasis* in late Summer to early Autummn.

I. Introduction

Although black flies are quite a serious pest of human beings and domestic animals in Japan and have been proven to be of considerable medical and veterinary importance in other parts of the world, the Japanese fauna has received relatively little study. Apparently the first mention of black flies from

Hokkaido is by MATSUMURA (1915), and he described one new species, *Simulium arakawae* in 1921 and two new species, *Prosimulium jezonicum* and *S. japonicum* in 1931. SHIRAKI (1935) published a taxonomic study of the Simuliidae of the Japanese Empire which included 24 species from Japan and Formosa. In this paper, he described two new species, *Prosimulium yezoense* from Hokkaido and *Simulium nikkoense* from Tochigi. A few additional species have been described by TAKAHASI (1941, 1950): *Odagmia aokii* and *Gnus daisense* from Tottori, and *Cnetha uchidai*, *C. subcostatum* and *C. konoi* from Hokkaido. Those species were briefly described. OGATA et al. (1956) and 406 MGL [BENTINCK] (1955) recorded the following four species from Hokkaido, *S. nikkoense*, *S. suzukii*, *S. rufibasis* and *Odagmia aokii*. Recently, UEMOTO et al. (1976) reported a full description of one new species, *Distosimulium daisetsense* from the Daisetsu National Park. Therefore, until 1976, a total of 41 Japanese species have been reported (Anonym. 1974), among which 12 species have been recorded from Hokkaido. However, more detailed studies are needed in both simuliid taxonomy and ecology in Hokkaido.

These studies have commenced from 1970 by the author (ONO, 1970a, b), and information on black flies of Hokkaido were given by the previous papers (ONO, 1976a, b, 1977a, b, c, d, e, f, 1978a, b, c, 1979, 1980a, b). In these papers the author described 14 new species and one new subspecies, redescribed 2 species and reported 2 species. In the present paper, the author dealt with the taxonomic study of the black flies in Hokkaido, with some biological notes, especially their biting habits in relation to a veterinary viewpoint. In the taxonomic section, the author proposed establishing one new subfamily and one new tribe, and recorded a total of 31 species. The biting habits of those 31 species have been discussed.

II. Historical review of faunal research of black flies in Hokkaido

As far as the author is aware, Japanese black flies were reported to science first by MATSUMURA (1915), when he recorded the presence of two supposedly European species. In 1921 he described one new species, *Simulium arakawae* and in 1931 described two new species, *Prosimulium jezonicum* and *Simulium japonicum* from Ishikari, Hokkaido. SHIRAKI (1935) described one new species, *P. yezoense* from Ishikari. TAKAHASI (1950) described two new species, *Cnetha uchidai* and *C. konoi* from Ishikari, and one new species, *C. subcostatum* from Shiribeshi. BENTINCK (1955) and OGATA et al. (1956) recorded the following four species, *S. nikkoense*, *S. suzukii*, *S. rufibasis* and *Odagmia aokii* from Ishikari, and two species, *S. japonicum* and *Prosimulium yezoense* from Ishikari and Nemuro. In 1974, 40 species of Japanese black flies were listed (Anonym, 1974), in which only 11 species of black flies were known from Hokkaido. UEMOTO et al. (1976) described one new species, *Distosimulium daisetsense* from the Daisetsu National Park. All of the above mentioned studies in which 12 species are described have been mainly recorded from Ishikari and secondarily from Shiribeshi, Nemuro and Kamikawa. Therefore, until 1976, 12 species of black flies were recorded from Hokkaido, but more detailed distributional records and more species are needed.

The author has commenced these studies from 1970 (ONO, 1970a, b), and informations on the black flies of Hokkaido were given by the previous papers (ONO, 1976a, b, 1977a, b, c, d, e, f, 1978a, b, c, 1979, 1980a, b). In these papers the author described 14 new species, *Twinnia canivora*, *T. subtibbelesi*, *Prosimulium karibaense*, *P. sarurense*, *P. apoinum*, *Stegopterna nukabirana*, *Eusimulium erimoense*, *Cnetha boldstemtum*, *C. acmerium*, *C. rebunense*, *Gnus fulvipes*, *Odagmia nishijimai*, *Simulium tobetsuense* and *S. horokaense*, and one new subspecies, *Boophthora yonagoense makunbei*, and redescribed two species, *Helodon multicaulis* and *Montisimulium sakhalinum*, which were quite new to the fauna of Japan, and reported two species, *Gnus daisense* and *Gomphostilbia shogakii*, which were new to the fauna of Hokkaido. These 19 species have been newly added to the fauna of Hokkaido by the author. Up to the present, there-

fore, a total of 31 species of black flies were recognized from Hokkaido.

III. Taxonomic study

Classification and Terminology

It is well known that in relation to workers' subjective opinions as to what constitutes close affinities systematists can be divided into "lumpers", "splitters", moderates, extremists and so on. ENDERLEIN (1921, 1930, 1936) split the family into some 50 genera, whereas EDWARDS (1923, 1934) regarded it as consisting of only one or two genera. EDWARDS' system has been adopted in principle by most of the British, French, American and some Japanese workers such as PURI (1932a, b, c), SMART (1945), STONE (1952, 1964), GRENIER (1953), SHEWLL (1958, 1959), DAVIES (1965), CROSSKEY (1967, 1969), PETERSON (1970a, b), LEWIS (1961), COLBO (1976), BENTINCK (1955) and TOKUNAGA (1943), ORII et al. (1969) and TAKAOKA (1974, 1976a, b, 1977a, b). ENDERLEIN's system has been used by the German, Northern European, USSR and some Japanese workers such as USOVA (1961), CARLSSON (1962), KONURBAYAV (1973), POPOV (1968), PATRUSHEVA (1973, 1976a, b), BODROVA (1974), ZWICK (1974), KNOZ (1965), YANKOVSKY (1978) or SHIRAKI (1935) and TAKAHASI (1950). The moderate system in which a somewhat intermediate course was taken by recognizing most of ENDERLEIN's genera as the subgenera, was adopted by RUBTSOV (1957), OGATA and SASA (1954, 1955), OGATA et al. (1956) and SHOGAKI (1956). Recently almost all Japanese workers accept subgenera and are using the trinomial system of nomenclature. The author recognizes certain subgenera, but refrains from their use because of the uncertain subgeneric assignment of a number of species, and is using the binomial system of nomenclature. The taxonomical arrangement adopted herein is the somewhat intermediate course taken by RUBTSOV (1974a, b) and STONE (1964). The earlier classification of RUBTSOV (1957) accepted the trinomial system, but his later and last classification (1959-64, 1974b) proposed a binomial system. He divided the family into 4 subfamilies and separated only the subfamily Simuliinae into 5 tribes. STONE' s classification (1964) accepted binomial in the subfamily *Prosimuliinae* and trinomial in the subfamily Simuliinae, and separated each subfamily into 2 tribes. The author's classification accepts the binomial system and divids it into 4 subfamilies and separats each subfamily *Prosimuliinae* and *Simuliinae* into 2 tribes as shown in the key.

The morphological terminology adopted in this study follows that of CROSSKEY (1967, 1969), except the tips of larval mandibles which have been adopted as in RUBTSOV (1962).

Although the tribe CNEPHIINI is included in the subfamily *Simuliinae* by RUBTSOV' classification (1974b), the author considers this tribe a subfamily. This is because the Japanese tribe *Cnephiini* is not suitable to be included into the subfamily *Prosimuliinae* by the shape of genitalia in both sexes, which in character rather resemble those of members of the subfamily *Simuliinae*. Also this tribe is not suitable to be included into the subfamily *Simuliinae* because of its formless cocoon, pupal and larval characteristics, which rather resemble those of members of the subfamily *Prosimuliinae*. Therefore, the author proposes that it is most probable to designate the new subfamily *Cnephiinae* which has been promoted from the tribe *Cnephiini*. A member of the genus *Helodon* can be separated from members of *Prosimulium* (s. str.) by the shape of its female anterior gonapophyses and male ventral plate. Especially pupal respiratory organs of members of the genus *Helodon* consist of 150-2000 filaments in a tight clump and a thick rounded stem, but those of members of the genus *Prosimulium* (s. str.) consist of 16-50 filaments in a loose clump and 3 separate slender stems. The genus *Helodon* is separated from the genus *Prosimulium* (s. str.) by RUBTSOV (1959-64, 1974a, b). Therefore, the author proposes that it is most probable to establish a new tribe *Helodoini* by promoting the genus *Helodon*. It is proposed that the tribe *Prosimuliini* be included in the genus *Distosimulium* for a member of this genus found from

Hokkaido and described by UEMOTO et al. (1976).

Key to Subfamilies and Tribes of Japan

1. Antenna with 9 segments; a bulla behind eye laterally; full grown larva without cephalic fans; anal sclerite of larva Y-shaped
.....Subfamily GYMNOPAIDINAE.....
Antenna with 11 segments; without bulla behind eye; full grown larva with cephalic fans; anal sclerite of larva X-shaped 2
2. Costa with fine hairs only, no stout spinules or intermixed spinules; radial sector forked or unbranched; no calcipala; larva with two basal antennal segments pale, the last two contrastingly dark; cocoon irregular and shapeless
.....Subfamily PROSIMULIINAE.....3
Costa with spinules intermixed with the fine hairs; radial sector usually unbranched; calcipala usually present; larval antenna rarely coloured as in Prosimuliinae; cocoon often of a very definite shape .....Subfamily SIMULIINAE.....5
3. Radial sector unbranched, costa with fine hairs and spinules intermixed
.....Subfamily CNEPHIINAE.....
Radial sector forked, costa with fine hairs only
.....4
4. Wing greyish, long and slender; respiratory filaments usually more than 100
.....Tribe HELODOINI
Wing hyaline, moderately broad and rounded; respiratory filaments usually less than 50
.....Tribe PROSIMULIINI
5. Basal portion of vein R with hairs dorsally; tarsal claw of female deeply cleft or with a strong tooth
.....Tribe EUSIMULIINI
Basal portion of vein R without hairs dorsally; tarsal claw almost simple .....Tribe SIMULIINI

FAMILY SIMULIIDAE NEWMAN, 1834

Subfamily GYMNOPAIDINAE RUBTSOV, 1956

Type genus: *Gymnopais* STONE, 1949

Genus *TWINNIA* STONE and JAMNBACK, 1955

Twinnia STONE and JAMNBACK, 1955, *N. Y. State Mus. Bull.*, 349: 18.

Type species. *Twinnia tibbelesi* STONE and JAMNBACK (orig. desig.).

Key to species

Females

Frons dull greyish black, clypeus paler than frons. Labrum and galea of maxilla white. Scutum with short, recumbent yellow pile. Scutellum with long, erect yellow hairs. Halter white. Legs pale yellow. Anterior margin of paraproct flattened. Ovipositor flap with broad projection; inner marginal space round. Sternum VIII with quadrate anal plate. Arm of genital fork tapering distally into small irregular plate; plate without tooth
.....*subtibbelesi*

Frons grey, half shiny; clypeus darker than frons. Labrum and galea of maxilla brown. Scutum and sctellum bare. Halter brown. Legs greyish brown. Anterior margin of paraproct round. Ovipositor flap with small globular projection; inner margin space elliptical. Sternum VIII with hexangular anal plate. Arm of genital fork enlarging distally into large irregular plate; plate with large sclerotized teeth.....*canivora*

Males

Scutum with short, recumbent greyish yellow pile. Scutellum with long, erect yellow hairs. Hind basitarsus about 4 times as long as its greatest width. Style short and strongly curved to inside. Ventral plate narrower in apical part and broader in posterior part than those of *canivora*; base of arm not dented; ventral lip without raised portion; arm slender and bent posteriorly. Endoparameral organ simple .....*subtibbelesi*

Scutum and scutellum bare. Hind basitarsus about 3.5 times as long as its greatest width. Style long and moderately curved to inside. Ventral plate

broad; base of arm clearly dented; ventral lip with dull projection; arm broad and bent anteriorly. Endoparameral organ prominent ……*canivora*

Pupae

Respiratory organ consisting of 14-16 filaments; base giving rise to almost equal length of 3 trunks. Tergum III with 4 setae on the median of either side. Sternum V with one ventral seta; sterna VI, VII with 2 setae on either side ……*subtibbelesi*

Respiratory organ consisting of 16 filaments; base giving rise to 3 trunks, but dorsal one longest. Tergum III with 3 setae on the median of either side. Sternum V with 2 ventral setae; sternum VI with one seta on either side; sternum VII without seta ……*canivora*

Larvae

Each abdominal segment with two dorsolateral dark spots. Basal segments of antenna not dilated. Apex of postgenal cleft rounded. Proleg and posterior end of abdomen with simple circlet ……*subtibbelesi*

Each abdominal segment with dark greyish band. Basal segments of antenna dilated. Apex of postgenal cleft dull triangular. Proleg and posterior end of abdomen with double circlets ……*canivora*

Twinnia canivora ONO

[Japanese name: Kita kuro-ohobuyu]

Twinnia cannibora ONO, 1977, *Res. Bull. Obihiro Univ.*, 10: 759-768 (female, male, pupa and larva).

Holotype Female, in the Laboratory of Entomology, Obihiro Univ.

Type locality Nukabira, Kamishihoro, Hokkaido; Small spring-fed stream in the forest, June 28, 1975 (H. ONO).

Distribution Hokkaido (Kamishihoro, Shikaoi, Ashyoro, Hidaka, Biratori, Niikappu, Erimo, Kamikawa, Rankoshi, Uryu, Rausu).

Biological notes The overwintering eggs of this univoltine species are found in small numbers scattered randomly on the bottom of cold, spring-fed streams in mixed forests. In Daisetsu National Park, the larvae of this species hatch in early May at temperatures just above freezing, and they grow in the organic silt of streams. Larvae are often predaceous and may ingest small chironomid larvae or indulge in cannibalism. The immature stages have been found in close association with those of *Montisimulium sakhalinum*, *Cnetha uchdai* and *Stegopterna nukabirana* usually occurring more than 100 m from the spring source of the same stream. Pupation occurs in the mid of June and the pupae are usually almost completely enclosed in a thick bag of silk on the underside of stones, leaves or pieces of wood. The first adults appear from late June. Biting habit to man has been recorded (ONO and IWASA, 1976), but they are presumably orinithophilic. Large swarming females rarely attach to man.

Twinnia subtibbelesi ONO

[Japanese name: Ezo-kuro-ohobuyul]

Twinnia subtibbelesi ONO, 1980, *KONTYU*, 48 (3): 333-361 (female, male, pupa and larva).

Holotype Female, in the Laboratory of Entomology, Obihiro Univ.

Type locality Obihiro, Hokkaido; Small spring fed stream under the Yoda Terrace, May 21, 1977 (H. ONO).

Distribution Hokkaido (Obihiro, Makubetsu).

Biological notes The overwintering eggs of this univoltine species are found in small numbers scattered randomly on the sandy bottom of cold, spring-fed streams in broad leaved forests. Under the Yoda Terrace, the larvae of this species hatch in early December and they graze in the organic silt of streams. They are usually found together with the larvae of *Cnetha boldstemtum* and chironomid larvae or indulge in cannibalism like the former species. The adults are found from April to June and their biting habits are unknown. They are presumably ornithophilic. Newly emerged females have immature eggs and much stored nutrients and they have well developed mouthparts and bifid claws which suggest that they feed on birds.

Subfamily PROSIMULIINAE ENDERLEIN, 1921

Type genus: *Prosimulium* ROUBAUD, 1906

Tribe HELODOINI, Trib. n.

Genus *HELODON* ENDERLEIN, *1921*

Helodon ENDERLEIN, 1921, *Deutsch. tierärtzl. Wochenschr.*, 16: 199. Type species, *Simulium ferrugineum* WAHLBERG, 1840.

Helodon multicaulis **(POPOV)**

[Japanese name: Hai-iro-ohobuyu]

Prosimulium muliticaulis POPOV, 1968, *Parazit.*, 2 (5): 444–447 (female, male, pupa, larva).

Helodon multicaulis, ONO, 1976, *Res. Bull. Obihiro Univ.*, 10: 253–269 (female, male, pupa, larva).

Holotype Female, in USSR Academy of Science, Zoological Institute.

Type locality Near Khabarovsk, Lower Priamurje, Aug., 1966 (V. D. POPOV).

Distribution Hokkaido (Kamishihoro, Shikaoi, Kamikawa, Hidaka, Rausu, Ishikari): China (E. Manchuria), USSR (Lower Priamurja in the Far East).

Biological notes The larvae of this species were found in considerably rapid streams (800–900 m in altitude). The streams were considerably broad, rather gravel bottomed, and were well shaded by a mixed forest cover. The stream was roughly 3–5 m in width, and 30–50 cm in depth, consisting of incised meander. The water temperature varied from 8.0°C to 13.0°C during the period from June to August. The larvae were most common in the currents and they were found on the upperside of stones in the swarming young stage and on the underside of grass blades, dead leaves and other debris in the mature stage. Crowded pupae were usually found on the undersides of sasa leaves or sticks that were trailing in small falls or sharp turn points in streams, occasionally found on the underside of large stones at the upper or lower side of small falls. This species is thought to be univoltine and overwinters in the egg stage. The eggs hatch in early May and the first adults appear in late July. The adults are found from early August to early September near considerably rapidly running streams in the forest. Among the members of the subfamily *Prosimuliinae*, the adults of this species occur the latest in Hokkaido. Biting habits are unknown.

Tribe PROSIMULIINI STONE, 1964

Key to genera of tribe *Prosimuliini*

Females

Costa with golden yellow hairs. Anterior gonapophyses short ……Genus *Distosimulium*

Costa with pale yellow hairs. Anterior gonapophyses long……Genus *Prosimulium*

Males

Ventral plate with deep cleft, without ventral lip ……Genus *Distosimulium*

Ventral plate without cleft, with broad ventral lip ……Genus *Prosimulium*

Larvae

Hypostomial median tooth distinctly lower than lateral teeth ……Genus *Distosimulium*

Hypostomial median tooth distinctly higher than lateral teeth……Genus *Prosimulium*

Genus *DISTOSIMULIUM* PETERSON, 1970

Distosimulium PETERSON, 1970, *Mem. Ent. Soc. Canad.*, 69: 30. Type species, *Prosimulium pleurale* MALLOCH, 1914 (orig. des.).

Distosimulium daisetsense **UEMOTO, OKAZAWA and ONISHI**

[Japanese name: Mukashi-ohobuyu]

Prosimulium (Distosimulium) daisetsense UEMOTO, OKAZAWA and ONISHI, 1976, *Jap. J. Sanit. Zool.*, 27 (2): 97–104 (female, male, pupa, larva).

Holotype Female, Type NSMT-I-Dipt. No. 03876, National Science Museum, Tokyo.

Type locality Ten ninkyo, Biei, Hokkaido; Kaun-nai River (about 1,300 m in altitude) in the

Daisetsu National Park, August 5, 1974 (T. OKAZAWA).

Distribution Hokkaido (Daisetsu National Park, Hidaka Range, Kitami Pass, Mt. Rausu).

Biological notes In Daisetsu National Park, the larvae of this species hatch at temperatures just above freezing. In low mountainous regions (500–600 m in altitude) the larvae hatch in early May and the first adults appear from late June, but in high mountainous regions (1,000–1,500 m in altitude) the larvae hatch in early to mid June and the first adults appear from late July to August. Larvae are found on stones, submerged vegetation or debris in considerably rapid streams. Biting habits are unknown. Females have strong, serrated mouthparts, large fat bodies, and partly developed eggs on ovarium which suggest that they feed on mammalian blood. Mermithid nematodes often heavily parasitize this species (ONO, unpublished data).

Genus *PROSIMULIUM* ROUBAUD, 1906

Simulium, subgenus *Prosimulium* ROUBAUD, 1906, *Comp. Rend. Acad. Sci. Paris* 143 : 521. Type species, *Simulium hiritipes* FRIES, 1824 (designated by MALLOCH, 1914).

Key to species

Females

1. All femora and tibiae greyish black to black. Claw evenly usually with a minute subbasal tooth ..... *jezonicum*
   All femora and tibiae pale yellow to orange yellow. Claw simple 2
2. Scutum and scutellum with long, erect gold or golden yellow pile. Vein yellow to pale yellow, hairs on stem vein dark brown 3
   Scutum and scutellum with rather short, greyish yellow or yellow pile. Vein grey, hairs on stem vein dark yellow, or mixed colouration of dark yellow and dark brown 4
3. Occiput with dense pale yellow pile, postocular setae long, pale yellow ..... *sarurense*
   Occiput with dense dark grey pile, postocular setae long, grey ..... *karibaense*
4. Inner margin of anterior gonapophyses strongly double concave basally, margin not parallel ..... *apoinum*
   Inner margin of anterior gonapophyses slightly concave basally, margins parallel for most of their length ..... *yezoense*

Males

1. All femora and tibiae dark brownish black to black with brownish black pile 2
   All femora and tibiae pale yellow to yellow with pale yellow pile 3
2. Femora and tibiae with brownish black pile, without pruinose. Stem and arms of median sclerite slender ..... *jezonicum*
   Femora and tibiae with brownish black pile and pale yellow pruinose. Stem and arms of median sclerite broad ..... *yezoense*
3. Ventral plate with strongly projected, broad and prow-like ventral process. Small size species ..... *apoinum*
   Ventral plate with rather long, considerably broad, pointed ventral lip. Large size species ... 4
4. Ventral process with pressued, slender ventral lip ..... *karibaense*
   Ventral process with broad, median ventral lip ..... *sarurense*

Pupae

1. Terga III, IV and sterna V–VIII with bifid hooklets 2
   Terga III, IV and sterna V–VIII with simple hooklets 3
2. Respiratory organ consisting of 3 long trunks. Respiratory filaments 16 ..... *jezonicum*
   Respiratory organ consisting of 3 short trunks from which arise several short sub trunks. Respiratory filaments 22–25 ..... *yezoense*
3. Respiratory filaments 30–34, with grey microgranules ..... *karibaense*
   Respiratory filaments more than 38, less than 50,

with white microgranules ·····4

4. Respiratory filaments 46–49; ventral subtrunks with 25 filaments ·····*sarurense*
Respiratory filaments 38–40; ventral subtrunks with 17 filaments·····*apoinum*

Larvae

1. Body pale greyish brown to greyish brown ·····2
Body reddish brown ·····4
2. Hypostomial median tooth and lateral teeth almost equal in height·····*karibaense*
Hypostomial median tooth distinctly higher than the highest lateral tooth ·····3
3. Main lateral teeth nearly equal in height, and outer lateral tooth most broad ·····*sarurense*
Central lateral tooth lower than others and inner lateral tooth most broad·····*jezonicum*
4. Inner subapical posterior margin of mandible with one large tooth and 6 mandibular serrations. Segments I, II of antenna dilated ·····*apoinum*
Inner subapical posterior margin of mandible with one large tooth, one small tooth and 4 mandibular serrations. Segments I, II of antenna slender ·····*yezoense*

Prosimulium jezonicum MATSUMURA

[Japanese name: Ohobuyu]

Simulium crassitarsis MACQUART, 1834; MATSUMURA, 1915, Konchu Bunruigaku II: 50.

Simulium jezonicum MATSUMURA, 1931, Ins. Jap. Emp. III: 406, fig. 295 (female).

Helodon sapporoensis SHIRAKI, 1935, *Memo. Fac. Sci. Agr. Taihoku Imp. Univ.*, 16 (1): 10, pl. VII, fig. 1–7 (female).

Helodon jezonicum, KÔNO and TAKAHASI, 1940, *Ins. Matsumurana*, XIV (2, 3): 80.

Prosimulium hiritipes, TAKAHASI, 1950, Iconographia Insect. Jap.: 1555 (female, male).

Prosimulium hiritipes, TAKAHASI, 1959, Illust. Larvae Jap., 633 (larva, pupa).

Prosimulium hiritipes, OGATA & SASA, 1954, *Jap. J. Exp. Med.*, 24: 325–333.

Prosimulium hiritipes, BENTINCK, 1955, 406 MGL U. S. Army, p. 5, Fig. 1, 7, 11, 16, 20, 27 (female, male, pupa).

Prosimulium hiritipes, OGATA, SASA & SUZUKI, 1956, The Japanese Black Flies and their control. pp. 166 (female, pupa, larva).

Prosimulium jezonicum, RUBTSOV, 1959–1964, 14. Simuliidae. pp. 686 (female, male, pupa).

Prosimulium (Prosimulium) jezonicum, ORII, UEMOTO & ONISHI, 1969, *Sanit. Injur. Ins.*, 13 (1): 1–13 (larva).

Prosimulium (Prosimulium) jezonicum, UEMOTO, ONISHI & ORII, 1973, *Jap. J. Sanit. Zool.*, 24 (1): 27–46 (female, male, pupa, larva).

Syntype Female, in Entomological Institute, Faculty of Agriculture, Hokkaido University.

Type locality Sapporo, Hokkaido: Maruyama, May 23, 1916 (S. MATSUMURA).

Distribution Hokkaido (widely distributed in Hokkaido, including Rishiri and Rebun Islands), Honshu, Kyushu: China (Manchuria), USSR (Far East), Sakhalin.

Biological notes The oviposition behavior of this species has not been observed, but the author suspects that the females dispense their eggs by tapping their abdomens to the water surface while in flight. Oviposition of this univoltine species probably occurs in mid May to early June in the Daisetsu National Park, and eggs hatch in early autum. Larvae grow during the winter in rapid, clear, shallow streams that are 0.5–3.0 m wide. Larvae are often found in association with those of *S. japonicum*. Pupation occurs in mid April to early May and the many pupae usually are massed together on rocks, wood or other objects in the stream. The first adults appear from late April. Females have strong, serrated mouthparts, large fat bodies, and partly developed eggs on emergence. Biting habits to man and domestic animals are well known. Mermithid nematodes often heavily parasitize this species (ONO, unpublished data).

Prosimulium yezoense SHIRAKI

[Japanese name: Kiashi-ohobuyu]

Prosimulium yezoense SHIRAKI, 1935, *Mem. Fac. Sci.*

Agr. Taihoku Imp. Univ., 16 (1) : 3, pl. V. Figs. 1-9 (female).

Prosimulium yezoense, TAKAHASHI, 1950, Icon. Ins. Jap. : 1555 (female, male).

Prosimulium yezoense, TAKAHASHI, 1959, Illust. Ins. Larvae Jap. : 269 (pupa, larva).

Prosimulium yezoense, OGATA & SASA, 1954, *Jap. J. Exp. Med.*, 24 : 325-333.

Prosimulium yezoense, OGATA & SASA, 1955, *Jap. J. Sanit. Zool.*, 6 (1) : 10-18.

Prosimulium yezoense, BENTINCK, 1955, 406 MGL U. S. Army p. 23 (female, male, pupa).

Prosimulium yezoense, OGATA & SASA, 1956, *Jap. J. Sanit. Zool.*, 7 (2) : 102-103.

Prosimulium yezoense, OGATA, SASA & SUZUKI, 1956, The Japanese Black Flies and their control. pp. 162 (female, pupa, larva).

Prosimulium yezoense, RUBTSOV, 1959-1964, Simuliidae. pp. 686 (female, male, pupa).

Prosimulium yezoense, ONO, 1980, *Jap. J. Sanit. Zool.*, 31 (3) : 181-191 (female, male, pupa, larva).

Prosimulium (Prosimulium) yezoense, ORII, UEMOTO & ONISHI, 1969, *Sanit. Injur. Ins.*, 13 (1) : 1-13 (larva).

Holotype Female, in Entomological Museum of the Government Research Institute, Taihoku, Formosa.

Type locality Sapporo, Hokkaido : Jyozankei, data unknown (T. SHIRAKI).

Distribution Hokkaido (Ishikari, Sorachi, Kamikawa, Tokachi, Kushiro, Kitami, Abashiri, Nemuro), Honshu, Kyushu : Sakhalin.

Biological notes The overwintering eggs of this univoltine species probably hatch in early Spring. The full grown larvae are found in early to mid June. Larvae grow during the spring in rapidly flowing, clear, deep streams that are 1-3 m wide. Larvae are often found in association with those of *S. japonicum* and *Cnetha konoi*. Pupation occurs in mid to late June, and many pupae are usually massed together on rocks, wood or other objects in the stream. The first adults appear from mid June. Females have strong, serrated mouth parts, fat bodies, and partly developed eggs on emergence. Biting habits to man and domestic animals are well known.

Prosimulium karibaense ONO

[Japanese name : Kin-iro-ohobuyu]

Prosimulium karibaense ONO, 1980, *Jap. J. Sanit. Zool.*, 31 (3) : 181-191 (female, male, pupa, larva).

Holotype Female, in the Laboratory of Entomology, Obihiro Univ.

Type locality Assubu, Hiyama-gun, Hokkaido ; The left tributary of Assubu River, June 25, 1977 (H. ONO).

Distribution Hokkaido (Oshima, Hiyama, Hidaka).

Biological notes Full grown larvae and pupa were crowded on stones and twig-like substances. They were found in rapid, upland streams (altitude about 500-1, 500 m) about 1.5 to 3.0 m in width and gravel bottomed. Serious biting habit to man was observed (ONO, unpublished data).

Prosimulium sarurense ONO

[Japanese name : Saruru-kiashi-ohobuyu]

Prosimulium sarurense ONO, 1976, *Jap. J. Sanit. Zool.*, 27 (3) : 217-222 (female, male, pupa, larva).

Holotype Female, in the Laboratory of Entomology, Obihiro Univ.

Type locality Erimo, Hokkaido ; Right tributary of the Saruru River in the forest, June 15, 1975 (H. ONO).

Distribution Hokkaido (Erimo, Hiroo).

Biological notes The life history and habit of this species are almost unknown. During June, the full grown larvae were found in the stream of Saruru River, and they pupated in late June. Full grown larvae and pupae attach to submerged vegetation especially the underside of dwarf sasa leaves or debris. They prefer considerably rapid, upland streams about 2 to 3 m in width, and gravel bottomed, 330-500 m in altitude. Human biting habit of females is unknown, but judging from the structure of the mouth parts of this species it may be a blood-sucker.

Prosimulium apoinum **ONO**

[Japanese name: Apoi-kiashi-ohobuyu]

Prosimulium apoina ONO, 1977, *Res. Bull. Obihiro Univ.*, 10: 749-757 (female, male, pupa, larva).

Holotype Female, in the Laboratory of Entomology, Obihiro Univ.

Type locality Samani, Hokkaido; The Fuyushima stream at the foot of Mt. Apoi, June 25, 1976 (H. ONO).

Distribution Hokkaido (Samani).

Biological notes During June the full grown larvae of this species were found in the Fuyushima stream and they pupated in late June. Full grown larvae and pupae attached to submerged vegetation, especially the underside of dwarf reed leaves and those stalks or debris. Serious biting habit to man was observed by the author.

Subfamily CNEPHIINAE GRENIER and RAGEAU, 1960

Type genus *Cnephia* ENDERLEIN, 1921

Genus *STEGOPTERNA* ENDERLEIN, 1930

Stegopterna ENDERLEIN, 1930, *Arch. f. Klass. u. Phyl. Ent.*, 1: 89. Type species, *richteri* ENDERLEIN (orig. desig.).

Stegopterna nukabirana **ONO**

[Japanes name: Daisetsu haru buyu]

Stegopterna nukabirana ONO, 1977, *Jap. J. Sanit. Zool.*, 28 (3): 257-262 (female, male, pupa, larva).

Holotype Female, in the Laboratory of Entomology, Obihiro Univ.

Type locality Nukabira, Kamishihoro, Hokkaido; Small spring-fed streams in the forest, July 2, 1975 (H. ONO).

Distribution Hokkaido (Daisetsu National Park, Hidaka Range, Kitami Pass, Mt. Rausu).

Biological notes The larvae of this species are most common in small, slowly running streams which are fed with springs in the forest or fed with snow melted water in the highland. The larvae are found on the upperside of stones, grass blades and dead blades during the period from April to July. The pupae are found in the clefts of stones and chinks of dead blades which have accumulated at the bottom of streams in mid June to mid July. The first adults appear in late June, and swarms are found in early July to early August. Females swarm in the morning and evening about 0.5-1.5 m above the ground in a clearing of forest near the stream. This species is thought to be univoltine and probably overwinters in egg stage. Biting habit to man has been recorded, but it is not so severe as that of *Simulium japonicum*.

Subfamily SIMULIINAE SMART, 1945

Type genus *Simulium* LATREILLE, 1802

Tribe EUSIMULIINI RUBTSOV, 1974

Key to genera of Tribe Eusimuliini

Adults

1. Antenna 10-segmented ..... *Gomphostilbia*
   Antenna 11-segmented 2
2. Ventral plate Y-shaped ..... *Eusimulium*
   Ventral plate discus shaped 3
3. Carina of ventral plate broad and long ..... *Montisimulium*
   Carina of ventral plate slender or triangular ..... *Cnetha*

Pupae

1. Cocoon with deeply dented anterior margin and strongly projected medio-dorsal projection; base of respiratory organ with large globular. Respiratory filaments 12 ..... *Montisimulium*
   Cocoon with slightly dented anterior margin and with or without medio-dorsal projection; base of respiratory organ simple. Respiratory filaments less than 8, more than 4 2
2. Respiratory filaments 8 ..... *Gomphostilbia*
   Respiratory filaments 4 3
3. Cocoon with thick anterior margin and moderately long mediodorsal projection or medio dorsal globular ..... *Cnetha*

Cocoon with thin anterior margin without medio dorsal projection or globular ..... *Eusimulium*

Larvae

1. Hypostomium without lateral serrations ..... *Gomphostilbia*
   Hypostomium with lateral serration 2
2. Hypostomium with corner and median teeth large and 3 smaller subequal intermediate teeth on each side ..... *Montisimulium*
   Hypostomium with corner and median teeth small and 3 larger subequal intermediate teeth on each side 3
3. Subapical inner margin of mandible with one large marginal tooth ..... *Cnetha*
   Subapical inner margin of mandible with two large marginal teeth ..... *Eusimulium*

Genus EUSIMULIUM ROUBAUD, 1906

Simulium, subgenus *Eusimulium* ROUBAUD, 1906, *Comp. Rend. Acad. Sci. Paris* 143 : 521. Type species, *Simulium aureum* FRIES (monobasic).

Eusimulium erimoense ONO

[Japanese name : Erimo-tsunomayu-buyu]

Eusimulium erimoense ONO, 1980, *Kontyu*, 43 (3) : 333-361 (female, male, pupa, larva).

Holotype Female, in the Laboratory of Entomology, Obihiro Univ.

Type locality Erimo, Hokkaido ; The small stream under the Owiwake Pass, April 20, 1976 (H. ONO).

Distribution Hokkaido (Erimo).

Biological notes The life history and biting habits of this species are unknown. During April the full grown larvae were found in the stream under the Oiwake Pass and small tributary of the Saruru River, and they pupated in late April to early May. Full grown larvae and pupae attach to trailing grasses. They occur in slowly flowing streams in lowland. Biting habits are unknown. Mermithid nematodes often heavily parasitize this species (ONO, unpublished data).

Genus *MONTISIMULIUM* RUBTSOV, 1974

Montisimulium RUBTSOV, 1974, *Trudy Zool. Inst.*, 53 : 230-281. Type species, *Simulium (Eusimulium) shevjakovi* DOROGOSTAJSKY, RUBTSOV and VLASENKO, 1935.

Diagnosis : RUBTSOV, 1956 : 392 (*Montium*-group RUBTSOV)

Montisimulium sakhalinum (RUBTSOV)

[Japanese name : Karafuto-miyama-buyu]

Eusimulium sakhalinum RUBTSOV, 1962, *in* LINDNER, Simuliidae, 296-297 (pupa).

Montisimulium sakhalinum, ONO, 1977, *Jap. J. Sanit. Zool.*, 28 (2) : 179-185. Figs. 1-33 (female, male, pupa, larva).

Holotype Pupa, in Zoological Institute, USSR Academy of Science, Leningrad.

Type locality Small stream near Juznosakhalinsk, Sakhalin, Aug., 1962 (I. A. RUBTSOV).

Distribution Hokkaido (Kamishihoro ; Nukabira, Mitsumata. Shikaoi ; Shikaribetsu. Shinotoku ; near Nupun hot spring. Kamikawa ; Kutchanbetsu stream. Uryu ; Highland swamp of Mt. Minami Shyokanbetsu. Rausu ; near Rausu hot spring) : Sakhalin.

Biological notes The larvae are commonly found in the rivulets near the source of the spring, the young ones swarm on the upperside of grass blades, dead leaves and stones, whilst the full-grown ones on the undersides of grass blades, dead leaves and other debris. During long periods of dry weather, the rivulets often change into deep hollows or pools, the larvae survive under dead leaves. The stout larvae can survive about one week in nonflowing water. The pupae were often found in pools with no perceptible water movement. Some pupae were found on the underside of leaves and sticks buried in the silt of pools. However, a large number of pupae are ususlly found on the undersides of stones and trailers at the favourable points of 10-15 cm fall of water in the rivulets. This species was also collected at streams fed with snow-melted water in the col of Mt. Minami Shyokanbetsu (altitude 1,400 m) and streams in the

highland swamp (1,000 m). This species is univoltine and overwinters in the egg stage which hatch in late May or early June and the first adults appear about mid July. Large numbers of adults appear in early and mid August. The young larvae are found often together with full grown larvae of *Twinnia canivora*, *Stegopterna nukabirana* and *Cnetha uchidai*. The blood-sucking habits are unknown.

Genus *GOMPHOSTILBIA* ENDERLEIN, 1921

Gomphostilbia ENDERLEIN, 1921, *Deutsch. Tierärtzl. Wochenschr.*, 16 : 109. Type species, *Gomphostilbia ceylonica* ENDERLEIN, 1921.

Gomphostilbia shogakii **(RUBTSOV)**

[Japanese name : Kuji-tsunomayu-buyu]

Eusimulium shogakii RUBTSOV, 1962, *in* LINDNER, Simuliidae, 305-306 (female, male, pupa).

Eusimulium shogakii, BODROVA and USOVA, 1975, *Parazitologia*, 10 (2) : 155-157 (female, male, pupa, larva).

Simulium J-4, BENTINCK, 1955, 406 MGL U.S. Army, 23 pp. (female, male, pupa).

Simulium (Eusimulium) sp., OGATA, SASA and SUZUKI, 1956, The Japanese Black Flies and their control. 162 pp. (female, pupa).

Simulium (Nipponosimulium) sp. J-4, Shogaki, 1956, *Jap. Zool. Mag.*, 65 (7) : 18-24.

Holotype Female (location not known to the auther).

Type locality Not known to the auther.

Distribution Hokkaido (Shiraoi ; Takeura. Oshima Peninsula ; Shirikishinai, Assabu, Kumaishi. Shyakotan Peninsula ; Notsuka, Yobetsu), Honshu, Shikoku, Kyushu : Korea, The Maritime Provinces of Far East, USSR (Primorsky).

Biological notes Pupae of this species have been collected from June to September in western Hokkaido. Breeding sights are small, slowly running streams and ditches near seaside districts. Biting habits are unknown.

Genus *CNETHA* ENDERLEIN, 1921

Cnetha ENDERLEIN, 1921, *Deutsch. Tierärtzl. Wochenschr.*, 16 : 199. Type species, *Simulia vernum* MACQUAT, 1826.

Syn. *Atractocera latipes* sensu CROSSKEY and DAVIES, not MEIGEN (misident.).

Key to species

Females

1. Scutum with three greyish white vittae ..... *boldstemtum*
   Scutum without vittae 2
2. Antenna entirely black 3
   Flagellar segments of antenna black, scape and pedicel yellowish brown or brown 4
3. Mesonotum covered with whitish yellow pubescence. All femora and tibiae dark yellowish brown ..... *subcostatum*
   Mesonotum covered with silvery white pubescence. All femora and tibiae black ..... *acmerium*
4. Legs greyish yellow. Abdomen dull black, lighter and often browned anterolateral and ventral surface, covered with greyish silver hairs *rebunense*
   Legs dark yellowish brown. Abdomen black, covered with whitish yellow hairs 5
5. Cercus long oval-shaped in lateral view. Genital fork with short stem ; distal expansin of arm triangular ..... *konoi*
   Cercus dual subquadrate in lateral view. Genital fork with long stem : distal expansion of arm nearly quadangular ..... *uchidai*

Males

1. Hind basitarsus nearly parallel sided, more slender than tibia ..... *konoi*
   Hind basitarsus nearly spindle-shaped, broder than tibia 2
2. Fore tibia with silvery dusting patch on the outher surface ..... *uchidai*
   Fore tibia without silvery dusting patch 3
3. Ventral plate having hairy triangular bulge on

posterior margin ..... *acmerium*
Ventral plate having hairy notch on posterior margin 4

4. Style short, about 2/3 as long as coxite. Basal arm of ventral plate short. Endparameral organ slender ..... *rebunense*
Style long, about equal as long as coxite. Basal arm of ventral plate long. Endparameral organ broad 5

5. Ventral plate with rectangular process on anterior margin; basal arm bent outward. Paramere with a long hook and several short hooks ..... *boldstemtum*
Ventral plate simple on anterior margin. Basal arm bent inwards. Praramere with a long hook only ..... *subcostatum*

Pupae

1. Cocoon slipper-shaped, with ventrolateral produces 2
Cocoon high slipper-shaped, without ventrolateral produces 3

2. Terga VI-VIII with several stout spines in single row on either side ..... *rebunense*
Terga VI-VIII with several spines in double row on either side ..... *konoi*

3. Cocoon with long anterodorsal projection 4
Cocoon without anterodorsal projection 5

4. Respiratory organ with violet stem and filaments: filaments tick-walled with transvers furrows. Cocoon with broad, rounded ventrolateral produces ..... *acmerium*
Respiratory organ with brownish stem and greyish filaments; filaments thin-walled with greyish granules. Cocoon with broad, spindle-shaped ventrolateral produces ..... *uchidai*

5. Respiratory organ with thick basal stem and clearly thick doral 2 filaments and slender ventral 2 filaments. Cocoon with broad, rounded ventrolateral produces ..... *boldstemtum*
Respiratory organ with slender stem and almost equal size slender 4 filaments. Cocoon with broad, spindle-shaped ventrolateral produces ..... *subcostatum*

Larvae

1. Postgenal cleft spade-shaped 2
Postgenal cleft rounded or oval-shaped 3

2. Posterior margin in the tip of mandible with one broad, stout marginal tooth; apical tooth and ventral outer tooth long. Spots *e* and *f* coalescent with each other ..... *konoi*
Posterior margin in the tip of mandible with one slender, long marginal tooth; apical tooth long and 2 outer teeth short. Spots *e* and *f* confused with each other ..... *acmerium*

3. Postgenal cleft small oval-shaped. Apical tooth of mandible bent ..... *boldstemtum*
Postgenal cleft large and round. Apical tooth of mandible straight 4

4. Antenna stout. Spots *c* and *d*, *e* and *f* coalescent with each other ..... *rebunense*
Antenna slender. Spots *c* and *d*, *e* and *f* separated from each other 5

5. Lateral surface of head capsule without isolated spots under eye. Length of postgenal cleft almost equal to the length of postgenal bridge ..... *subcostatum*
Lateral surface of head capsule with isolated 3 spots under eye. Length of postgenal cleft approximately twice as long as postgenal bridge ..... *uchidai*

Cnetha subcostatum (TAKAHASI)

[Japanese name: Otaru-tsunomayu-buyu]

Eusimulium subcostatum TAKAHASI, 1950, Icon. Ins. Jap., 1555 (female, male).

Eusimulium subcostatum, RUBTSOV, 1959-1964, *in* LINDNER, Simuliidae, 344-345 (female, male, pupa).

Eusimulium subcostatum, ORII, UEMOTO and ONISHI, 1969, *Sanit. Injur. Ins.*, 13 (1): 1-13 (larva).

Simulium (Eusimulium) subcostatum, OGATA and SASA, 1955, *Jap. J. Sanit. Zool.*, 6 (1): 10-18 (female, pupa).

Simulium (Eusimulium) subcostatum, OGATA, SASA and SUZUKI, 1956, The Japanese black flies and

their control. 162 pp. (female, pupa, larva).

Simulium subcostatum, BENTINCK, 1955, 406 MGL U. S. Army, 23 pp. (female, larva).

Holotype Female (location not known to the author).

Type locality Hokkaido: detail data not known to the author.

Distribution Hokkaido (widely distributed in Hokkaido, including Rishiri Island), Honshu, Shikoku, Kyushu and the Nansei Islands: Korea, Far East.

Biological notes It is the commonest species and widely distributed in Hokkaido. Larvae and pupae are found in peaty bog streams at various altitudes from April to September. In low land region, mermithid nematodes often heavily parasitize this species (ONO, unpublished data). Biting habits of females are unknown.

Cnetha boldstemtum ONO

[Japanese name: Obihiro-tsunomayu-buyu]

Cnetha boldstemta ONO, 1978, *Res. Bull. Obihiro Univ.*, 10: 893-909 (female, male, pupa, larva).

Holotye Female, in the Laboratory of Entomology, Obihiro University.

Type locality Obihiro, Hokkaido; Small spring-fed stream under the Yoda Terrace, April 29, 1976 (H. ONO).

Distribution Hokkaido (Obihiro, Otofuke, Makubetsu).

Biological notes Young larvae, full grown ones and pupae are found during the period from late Fabruary to late March, from middle March to middle April and from April to May, respectively. The larvae and pupae attach usually to dead leaves, stems and debris. They are found in a particular area, such as small and spring-fed streams formed by snow-melted water from February to May. Those streams are dried up and disappear from June to November. Therefore, the larvae occur under cool and stable conditions, suggesting a univoltine cycle. They are usually found together with the larvae of *Twinnia subtibbelesi*. The adults are found from April to June and their biting habits are unknown.

Cnetha uchidai (TAKAHASI)

[Japanese name: Uchida-tsunomayu-buyu]

Eusimulium uchidai TAKAHASI, 1950, Icon. Ins. Jap., p. 1556 (female, male).

Eusimulium uchidai, TAKAHASI, 1959, Illust. Ins. Larvae Jap., p. 634 (larvae, pupa).

Eusimlium uchidai, RUBTSOV, 1959-1964, Simuliidae, 321-322 (female, male, pupa, larva).

Eusimulium uchidai, ORII, UEMOTO and ONISHI, 1969, *Sanit. Injur. Ins.*, 13 (1): 1-13 (larva).

Simulium (Eusimulium) uchidai, OGATA and SASA, 1954, *Jap. J. Exp. Med.*, 24: 325-333.

Simulium (Eusimulium) uchidai, OGATA anc SASA, 1955, *Jap. J. Sanit. Zool.*, 6 (1): 10-18 (female, pupa).

Simulium (Eusimulium) uchidai, OGATA, SASA and SUZUKI, 1956, The Japanese Black Flies and their control. pp. 166 (female, pupa, larva).

Simulium (Eusimulium) uchidai, SHOGAKI, 1956, *Zool. Mag.*, 65 (7): 18-24.

Simulium (Eusimulium) uchidai, TAKAOKA, 1976, *Jap. J. Sanit. Zool.*, 27 (2): 163-180 (female, male, pupa, larva).

Simulium latipes, nec MEIGEN, BENTINCK, 1955, 406 MGL U. S. Army, 23 pp. (female, male, pupa).

Holotype Female (location not known to the author).

Type locality Hokkaido, detail data not known to the author.

Distribution Hokkaido (widely distributed in Hokkaido, including Rishiri and Rebun Islands), Honshu, Shikoku, Kyushu and the Nansei Islands: Korea, Manchuria, Far East.

Biological notes It is the commonest species and widely distributed in Hokkaido. Larvae and pupae are found in peaty bog streams at various altitudes from April to September. Pupae and larvae are found from trailing grasses, dead leaves, artificial debris and at times and stones in various types of habitats, from small and very slowly streams to rock cascades. Biting habits are unknown.

Cnetha acmerium **ONO**

[Japanese name : Satsunai tsunomayu-buyu]

Cnetha acmeria ONO, 1978, *Res. Bull. Obihiro Univ.*, 10 : 893-909 (female, male, pupa, larva).

Holotype Female, in the Laboratory of Entomology, Obihiro University.

Type locality Obihiro, Hokkaido ; Small spring-fed stream under the Yoda Terrace, May 9, 1976 (H. ONO).

Distribution Hokkaido (only known type locality).

Biological notes The larvae and pupae are abundant from March to May in swampy rivulets and outlets of small spring-fed streams which flow into the swamp, though these areas are often dried up from July to November. The larvae are found only in the snow-melting season together with those of *Twinnia subtibbelesi*. The adults occur from May to June and their biting habits are unknown.

Cnetha konoi **(TAKAHASI)**

[Japanese name : Kono-hososune-buyu]

Nevermannia konoi TAKAHASI, 1950, Icon. Ins. Jap., p. 1556 (male).

Simulium (Eusimulium) konoi, OGATA and SASA, 1954, *Jap. J. Exp. Med.*, 24 : 325-333.

Simulium (Eusimulium) konoi, OGATA and SASA, 1955, *Jap. J. Sanit. Zool.*, 6 (1) : 10-18.

Simulium (Eusimulium) konoi, OGATA, SASA and SUZUKI, 1956, The Japanese Black Flies and their control. pp. 166 (male, pupa).

Cnetha konoi, ONO , 1979, *Jap. J. Sanit. Zool.*, 30 (3) : 243-254 (female, male, pupa, larva).

Holotype Male (location not known to the author).

Type locality Hokkaido, detail data not known to the author.

Distribution Hokkaido (widely distribution in Hokkaido), Honshu : Far East.

Biological notes The pupae on submerged vegetation were collected during the period from May to September, the occurrence showing two peaks, the first being in May and the second in August. No larvae were found from October to February. The first adults appeared in late May. Therefore, this species seems to be bivoltine and probably overwinters in the egg stage. Full grown larvae and pupae attach to trailing grasses, especially on the underside of dwarf reed leaves and stalks. They were found in considerably rapidly flowing streams, often together with the larvae of *Simulium japonicum* and *Helodon multicaulis*. Biting habits are unknown.

Cnetha rebunense **ONO**

[Japanese name : Rebun-hososune-buyu]

Cnetha rebunense ONO, 1979, *Jap. J. Sanit. Zool.*, 30 (3) : 243-254 (female, male, pupa, larva).

Holotype Female, in the Laboratory of Entomology, Obihiro University.

Type locality The Ohosawa River in the northern part of Rebun Island, July 25, 1977 (H. ONO).

Distribution Hokkaido (Rebun Island, only known type locality).

Biological notes The life history and biting habits of this species are unknown. During July, the full grown larvae were found in the stream of the Ohosawa River, and they pupated in late July. Full grown larvae and pupae attach to submerged reed stalks. They occur in slowly flowing streams in lowlands in a constantly windy area.

Tribe SIMULIINI GRENIER and RAGEAU, 1960

Key to genera of Tribe Simuliini

Adults

1. Frons shiny ..... *Boophthora*
   Frons dull or half shiny 2
2. Claw simple. Internal margin of anterior gonapophyses almost parallel ..... *Simulium*
   Claw with basal or median tooth. Internal margin of anterior gonapophyses not parallel ... 3
3. Claw with stout basal tooth. Inner margin of anterior gonapophyses strongly concave, apical part of gonapophyses strongly projected inward ..... *Odagmia*
   Claw with small median tooth. Inner margin of anterior gonapophyses almost parallel or slightly concave, apical part of gonapophyses rounded and

slightly bent outward ..... *Gnus*

Pupae

1. Cocoon high booth shaped, its frontal margin with basket-work. Base of respiratory organ with half-rounded stem
..... *Gnus*

Cocoon slipper shaped or low shoe shaped, without basket-work. Base of respiratory organ simple or small globular 2

2. Total number of filaments varying from 4 to 7, the most common being 6, without petiole. Ventral plate with long, projected beak-like ventral arms, without dorsal processes ..... *Boophthora*

Total number of filaments 6, always with petiole. Ventral plate without ventral arms, with marginally denticulate dorsal processes 3

3. Terga II-VIII almost transparent; tergum VI with distinct row of flat triangular spines along anterior margin dorsally. Cocoon rather thin woven ..... *Odagmia*

Terga II-VIII not transparent; tergum VI without row of flat triangular spines. Cocoon rather thick woven ..... *Simulium*

Larvae

1. Postgenal cleft deep, almost reaching to hind margin of hypostomium ..... *Gnus*

Postogenal cleft not deep as above mentioned ... 2

2. Postgenal cleft longer than postgenal bridge
..... *Simulium*

Postgenal cleft subequal or shorter than postgenal bridge 3

3. Hypostomial median tooth prominent
..... *Boophthora*

Hypostomial median tooth subequal to outer lateral teeth ..... *Odagmia*

Genus *BOOPHTHORA* ENDERLEIN, 1921

Boophthora ENDERLEIN, 1921, *Deutsch Tierärtzl. Wochenschr.*, 16: 199. Type species, *Simulium erythrocephalum* DE GEER, 1776

Boophthora yonagoense makunbei **ONO**

[Japanese name: Tsuya-gashira-buyu]

Boophthora yonagoense makunbei ONO, 1977, *Jap. J. Sanit. Zool.*, 28 (2): 186-192 (female, male, pupa, larva).

Holotype Female, in the Laboratory of Entomology, Obihiro University.

Type locality Makubetsu, Hokkaido; Small mineral spring-fed stream under the Makubetsu Terrace, July 28, 1974 (H. ONO).

Distribution Hokkaido (Makubetsu, Obihiro, Shikaoi, Kamishihoro). Original subspecies distributed in Honshu, Shikoku.

Biological notes The eggs, larvae and pupae of the present subspecies are found in the small and slowly running stream flowing under the Makubetsu Terrace. The stream meanders with a sandy bottom and grassy banks. The larvae are found abundantly from June to November, but they disappear during the period from December to March. The occurrence of pupae shows two peaks, one being in July, the other in October. These facts indicate that the subspecies probably overwinters in the egg stage. The eggs hatch in mid or late April and the first adults appear in early June. During summer season the larvae of this subspecies were found more abundantly in streams of warmer water temperature than other streams, such as the stream of Makubetsu mineral spring. Male adults are found on blades of reeds in the daytime, and sometimes swarm in the evening about 1.5-2.5 m above the ground over small shrubs at the grassland near the stream. Biting habits are unknown.

Genus *GNUS* RUBTSOV, 1940

Gnus RUBTSOV, 1940, Black Flies, *in* Fauna SSSR. 1-533. Type species, *Simulium decimatum* DOROGOSTAJSKY, RUBTSOV and VLASENKO, 1935 (orig. desig.).

Kye to species

Females

Antenna uniformly brown to brownish black. Blade of maxilla with 23–25 retrose teeth. Maxillary papl brownish black. Mandible with 32–35 serrations. Scutum covered with short, pale yellow hairs. Stem veins yellow. All femora and tibiae whitish yellow to yellow. Outer sides of all tibiae with whitish silver patches. Fore basitarsus black, basal halves of mid and hind basitarsi yellow. Terga VI–VIII shiny, sternite II with whitish grey pollinosity. Ovipositor lobe broad, inner margin strongly concave and posterior margin slightly convex. Arm of genital fork slender having one flat process distally. Anal lobe subquadrate in lateral and ventral view ····· *daisense*

Scape and pedicel pale yellow, basal 1–3 of first flagellomere yellow, other flagellar segments dark brown. Blade of maxilla with 25–28 retrose teeth. Maxillary palp grey. Mandible with 39 serrations. Scutum covered with short, pale grey hairs. Stem veins grey. All femora and tibiae yellowish orange. Outer side of all tibiae without whitish patches. All basitarsi orange. Terga VI–VIII half shiny, sternite II with pale yellow pollinosity. Ovipositor lobe narrow, inner and posterior margin slightly concave. Arm of genital fork broad, having one blunt process projecting distally. Anal lobe broad, mitre shaped in lateral view and elliptical in ventral view ····· *fulvipes*

Males

Scutum covered with short, recumbent gold hairs. Pronotum, front and side of scutum tinged with clearly broad shiny whitish silver. Legs brownish black. Outer side of all tibiae with whitish silver patches. Hind basitarsus elliptical, flattened. Ventral plate Y-shaped. Median sclerite slender. Total number of parameral hooks 25, parameral plate triangulate, without spines. Frontal margin of cocoon with short, loosely woven basket-work extension ····· *daisense*

Scutum covered with short, recumbent pale yellow hairs. Front and side part of scutum does not show silver-polished pattern. Legs greyish yellow. Outer sies of all tibiae without whitish patches. Hind basitarsus parallel side flattened. Ventral plate rounded. Median sclerite broad. Total number of parameral hooks 20, parameral plate subquadrate with 2 long spines. Frontal margin of cocoon with long tightly woven basket-work extension ····· *fulvipes*

Pupae

Respiratory organ consisting of one short half rounded stem ; 3 ventral trunks giving rise to 4 sub-trunks, each sub-trunk bearing a pair of filaments, total number of filaments 8 ; 3 dorsal trunks bearing sub trunk, with furcation variegated, sometimes sessile, total number of filaments vary from 5 to 8. Sternum VI without hooked spines. Sterna IV–VIII without hooks ····· *daisense*

Respiratory organ consisting of 3 broad stems ; ventral trunk broadest, giving rise to 4 broad and thick filaments ; lateral trunk giving rise to 4 slender sub-trunks, each sub-trunk bearing a pair of filaments, total number of filamets 8 ; dorsal trunk giving rise to 2 slender sub-trunks, each sub trunk bearing a pair of filaments, total number of filaments 4. Sternum VI with a pair of strongly hooked spines, the tips directed anteriorly. Sterna IV–VIII with hooked spines ····· *fulvipes*

Larvae

Head spots usually distinct, surrounding posteromedial spots are slightly darkened. Inner margin of postgenal cleft double curved ····· *daisense*

Head spots usually indistinct, surrounding area of posteromedial and posterolateral spots clearly darkened. Inner margin of postgenal cleft almost straight distally, loosely curved basally ··· *fulvipes*

Gnus daisense TAKAHASI

[Japanese name : Daisen-yamabuyu]

Gnus daisensis TAKAHASI, 1950, Icon. Ins. Jap., p. 1558 (female, male)

Gnus daisensis, ONO, 1976, *Res. Bull. Obihiro Univ.*, 10 : 253–269 (female, male, pupa, larva).

Simulium daisense, OKAMOTO, 1958, *Yonago Med. J.*, 9 (4) : 566–579.

Simulium (Gnus) daisense, OGATA and SASA, 1955, *Jap. J. Sanit. Zool.*, 6 (1) : 10–18.

Simulium (Gnus) daisense, OGATA, SASA and SUZUKI, 1956, The Japanese Black Flies and their control, p. 89 (female, pupa).

Holotype Female, in Entomological Institute, Faculty of Agriculture, Hokkaido University.

Type locality Misasa, Tottori prefecture, Apr. 21, 1943 (H. TAKAHASI).

Distribution Hokkaido (Kamishihoro, Otofuke, Obihiro, Nakasatsunai), Honshu (Tottori, Osaka, Saitama), Shikoku (Kagawa), Kyushu (Kumamoto).

Biological notes Younger larvae were observed on stone surfaces or submerged vegetation in slow and rapidly flowing streams. But full grown larvae and pupae were crowded on twigs like substances or large stone surfaces in the rapid stream. The pupae were found in middle July and middle September. Some pupae which were collected from the upper streams near Mikuni Pass (altitude about 900–1,000 m) were much smaller than those of middle streams (altitude about 350–400 m). This species is thought to be bivoltine and overwinters in the egg stage. Eggs hatch in late May or early June and the first adults appear about the middle of July. Biting habit to goat was observed, it did not attach to man, cattle or horses (ONO, unpublished data). OKAMOTO (1958) reported that this species is bivoltine in this type locality (Tottori Pref.).

Gnus fulvipes ONO

[Japanese name : Oshima-yama-buyu]

Guns fulvipes ONO, 1978, *Jap. J. Sanit. Zool.*, 29 (4) : 299–304 (female, male, pupa, larva).

Holotype Female, in the Laboratory of Entomology, Obihiro University.

Type locality Assabu, Hiyama-gun, Hokkaido ; The left tributary of the assabu River, June 25, 1977 (H. ONO).

Distribution Hokkaido (The Oshima Peninsula ; Assabu, Yakumo, Oshamanbe, Kumaishi).

Biological notes Full grown larvae and pupae were crowded on twig-like substances and dead leaves or debris. They were found in rapid, upland streams (altitude about 300–500 m) about 2 to 3 m in width and gravel bottomed. Biting habits are unknown.

Genus *ODAGMIA* ENDERLEIN, 1921

Odagmia ENDERLEIN, 1921, *Deutsch. Tierärtzl. Wochenschr.*, 16 : 199. Type species, *Simulium ornatum* MEIGEN, 1818.

Key to species

Females

Scutum with sparse pale yellow hairs throughout. Only fore tibia with a silvery patch. Hind leg dilated. Silvery patches on 2nd abdominal segment separated from each other. Anal lobe and cercus slender in ventral veiw ; apex of cercus quadrate in lateral view. Arm of genital fork with distal process slender. Spermatheca without reticulate pattern ..... *nishijimai*

Scutum with densely fine golden yellow hairs and with black hairs on presculteller area. Tibiae each with a silvery patch on outer surface. Hind leg slender. Silvery patches on 2nd abdominal segment connected with each other. Anal lobe and cercus broad in ventral view ; apex of cercus round in lateral view. Arm of genital fork with distal process broad. Spermatheca with weak hexagonal reticulate pattern ..... *aokii*

Males

Mesonotum shiny black, bare and without silvery spot. Mid tibia without silvery patch. Hind femur and tibia strongly dilated. Abdomen half shiny, black ; segments II, V–VII without silvery spots. Ventral plate narrow ; ventral process pro-

slender. Parameral teeth short. Median sclerite with a longitudinal suture ..... *aokii*

Pupae

Head trichomes 1 pair. Thoracic trichomes 4 pairs simple, 2 pairs double. Filaments grey, all 6 filaments subequal in thickness. Tergum I without tubercle and seta. Tergum II with 4 short spines on either side. Terga VI-IX with grouping warts. Sternum V with 1 hook and 1 long seta. Sternum VIII bare ..... *nishijimai*

Head trichomes 3 pairs. Thoracic trichomes 6 pairs, all simple. Filaments plae brown, lower 2 filaments slightly thicker than upper 4. Tergum I with tubercles and setae. Tergum II with 5 short setae and 1 long seta on either side. Terga VI-IX with comb-like groups of minute spines. Sternum V with 4 simple or bifid setae. Sternum VIII with minute spines and setae ..... *aokii*

Larvae

Head spots usually indistinct and anterolateral and posterolateral spots coalescent. On the area posterior to eye without spot. Hypostomial outer lateral teeth and median tooth prominent. Postgenal cleft about 1.5 times as long as postgenal bridge; elongate spot absent. Posterior circlet with about 86 rows of hooks ..... *nishijimai*

Head spots very marked and not coalescent. On the area posterior to eye with 2 spots. Hypostomial outer lateral teeth and median tooth not prominent. Postgenal cleft about 3.6 times as long as postgenal bridge; elongate spot present on either side of cleft. Posterior circlet with about 80 rows of hooks ..... *aokii*

Odagmia nishijimai ONO

[Japanese name : Nishijima tsumetoge buyu]

Odagmia nishijimai ONO, 1978, *Kontyu*, 46 (1) : 43-51 (female, male, pupa, larva).

Holotype Female, in the Laboratory of Entomology, Obihiro University.

Type locality Toyo oka, Kmishihoro, Hokkaido; jection ventrally; teeth of dorsal margin broad, directed postroventrally; basal arms thick. Parameral teeth long. Median sclerite with a large cleft ..... *nishijimai*

Mesonotum dull black covered with golden yellow pubescence and with a pair of large silvery spots. Mid tibia with silvery patch. Hind femur and tibia slightly dilated. Abdomen dull brownish black; segments II, V-VII with silvery spots dorsolaterally. Ventral plate broad; ventral process projecting posteroventrally; teeth of dorsal margin slender, directed ventrally; basal arm Sanke-uoppu stream, Oct. 10, 1976 (H.NO).

Distribution Hokkaido (Tokachi, Kushiro, Nemuro) : Kuril Isls.

Biological notes The occurrence of pupae on submerged vegatation is found during the period from March to November, and especially shown by three peake, the first being in Aprill, the second in July and the last in October. In Spring to Autum, the larvae in various stages are overlapped, but the young larvae are found only from December to February. Therefore, this species seems to be trivoltine and probably overwinters in young larval stage. The first adults appeared in late March. The larvae and pupae are found on trailing grasses growing abundantly on sands slowly meandering streams of plain rivers. Swarms of the larvae and pupae are often found on the nets of caddis fly larvae (*Rhyacophila sp.*). Serious biting habit to man was observed in early Spring and mermithid nematodes often heavily parasitize this species (ONO, unpublished data).

Odagmia aokii TAKAHASI

[Japanese name : Aoki-tsumetoge-buyu]

Odagmia aokii TAKAHASI, 1941, *Ins. Matsum.*, 15 : 86-88 (female).

Odagmia aokii, TAKAHASI, 1950, Icon. Ins. Jap., p. 1557 (female, male).

Odagmia aokii, TAKAHASI, 1959, Illust. Ins. Larvae Jap., p. 635 (pupa, larva).

Odagmia aokii, RUBTSOV, 1959-1964, Simuliidae, 496 (female, male, pupa, larva).

Odagmia aokii, ONO, 1978, *Kontyu*, 46 (1): 43–51 (female, male, pupa, larva).

Simulium (Odagmia) aokii, OGATA and SASA, 1954, *Jap. J. Exp. Med.*, 24: 325–333.

Simulium (Odagmia) aokii, OGATA and SASA, 1955, *Jap. J. Sanit. Zool.*, 5 (3, 4): 100–109.

Simulium (Odagmia) aokii, OGATA and SASA, 1955, *Jap. J. Sanit. Zool.*, 6 (1): 10–18 (female, pupa).

Simulium (Odagmia) aokii, OGATA, SASA and SUZUKI, 1956, The Japanese Black Flies and their control, pp. 81–82 (female, pupa, larva).

Simulium (Odagmia) aokii, SHOGAKI, 1956, *Zool. Mag.*, 65 (7): 18–24.

Simulium (Odagmia) aokii, ORII et al., 1969, *Sanit. Injur. Ins.*, 13 (1): 1–13 (larva).

Simulium (Odagmia) aokii, TAKAOKA, 1976, *Jap. J. Sanit. Zool.*, 27 (4): 385–398 (female, male, pupa, larva).

Holotype Female, in the Entomological Institute, Faculty of Agriculture, Hokkaido University.

Type locality Tuyukani, Tottori Prefecture, January 3, 1940 (H. AOKI).

Distibution Hokkaido (western Hokkaido, Shiribeshi, Ishikari, Sorachi, Iburi, Rumoi), Honshu, Shikoku, Kyushu, the Nansei Isls.: Korea.

Biological notes Larvae and pupa were observed on submerged vegetation or dead leaves in lowland streams exposed to the sun. Females of *aokii* have been known bite man, cattle, horses and goats (OGATA, 1955).

Genus *SIMULIUM* LATREILLE, 1802

Simulium LATREILLE, 1802, *Hist. nat. gen. part. Crus. Ins.*, 3: 426. Type species, *Rhangio colombaschensis* FABRICIUS, 1784 (Orig. desig.).

Key to species

Females

1. Mesonotum, when viewed from in front dull grey-dusted, with 3 or 5 distinct black longitudinal lines ····2
   Mesonotum, when viewed from in front without such pattern ····4
2. Mesonotum with 5 distinct black longitudinal lines ····*japonicum*
   Mesonotum with 3 short, distinct black longitudinal lines ····3
3. Abdominal segments II–V dull black with clusters of short brown hairs laterally ····*horokaense*
   Abdominal segment II with a pair of silvery spots ····*nikkoense*
4. Sternite VII submedially with a pair of clusters of fairly long and thick black hairs ····*rufibasis*
   Sternite VII submedially without such clusters of hairs ····5
5. Hind tibiae yellow with distal part black ····6
   Hind tibiae black with extreme basal part yellow ····*suzukii*
6. Hind tibiae yellow with distal 1/2 brownish black ····*arakawae*
   Hind tibiae yellow with distal 1/3 black ····*tobetsuense*

Males

1. Ventral plate roughly Y-shaped or nearly triangular ····2
   Ventral plate broad, nearly rectangular or somewhat saddle shaped ····4
2. Ventral plate nearly triangular with broadly rounded ventral process ····*nikkoense*
   Ventral plate nearly Y-shaped with long projected ventral process ····3
3. Dentate serrate of dorsal process directed outward. Endoparameral organ with long and straight teeth ····*tobetsuense*
   Dentate serrate of dorsal process directed inward. Endoparameral organ with bent teeth ···*arakawae*
4. Ventral plate saddle-shaped with low median process directed ventrad ····*horokaense*
   Ventral plate nearly rectangular with high madian process directed ventrad ····5
5. Ventral plate rectangular, longer than wide, only slightly exceeding basal width of style and with median process at most only moderately developed ····*japonicum*

Ventral plate rectangular, wider than length, style not as above mentioned ……6

6. Style with basal protuberance strongly developed and bearing several stout spines ; ventral plate, in ventral view, with posterior margin slightly convex ; median sclerite gradually widened towards apex……*suzukii*

Style with basal protuberance only slightly developed and bearing several weak spines ; ventral plate, in ventral view, with posterior margin slightly concave ; median sclerite broad, parallel sided……*rufibasis*

Pupae

1. Gill organ with 8 filaments……*nikkoense*

Gill organ with 6 filaments……2

2. Gill organ with broad base ; upper 3 filaments larger in diameter and longer than lower 3 ones ……3

Gill organ with narrow base ; filaments not above mentioned……4

3. Thoracic trichomes 6 pairs, all long and branched into 4-8. Cocoon with lateral windows ……*japonicum*

Thoracic trichomes 3 pairs, all long, slender and simple. Cocoon without lateral windows ……*horokaense*

4. Petioles of dorsal and ventral pairs of filaments widely divergent, its angle usually greater than 90 degrees ……5

Petioles not so divergent, the angle between them up to 90 degrees……6

5. Abdominal segments VI VIII dorsally with distinct row of flat triangular spines along anterior margin, segment VIII without bifid hooked spines ……*arakawae*

Abdominal segments VI-VIII dorsally without row of spines, segment VIII with 10 bifid hooked spines along the posterior margin ……*tobetsuense*

6. Trichomes of head clearly shorter than those of thorax ; terminal hooks small but distinct ……*suzukii*

Trichomes of head as long as those of thorax ; terminal hooks absent……*rufibasis*

Larvae

1. Postgenal cleft triangular ……2

Postgenal cleft spear head shaped ……3

2. Hypostomial setae 6-9 in number lying very close to each other. Rectal gill lobes each with 6 9 secondary lobules ……*japonicum*

Hypostomial setae 6 in number lying subparallel to lateral margin on either side. Rectal gill lobes each with 3 secondary lobules ……*horokaense*

3. Head spots distinctly negative ……4

Head spots more or less positive ……6

4. Posterior 1/2 of cephalic apotome clearly darkened……*nikkoense*

Posterior 1/2 of cephalic apotome not darkened, central part of cephalic apotome peculiar darkened ……5

5. Cephalic apotome with hexagonal tortoise shell-shaped pattern ……*arakawae*

Cephalic apotome with distinct H-shaped pattern ……*tobetsuense*

6. Hypostomial setae lying parallel to lateral margin ; postgenal cleft moderately converging with each other on basal portion, its greatest width much longer than the distance between apex of median tooth and posterior margin of hypostomium ……*suzukii*

Hypostomial setae lying slightly divergent posteriorly from lateral margin ; postgenal cleft slightly converging with each other on basal portion, its greatest breadth much shorter than the distance between apex of median tooth and posterior margin of hypostomium ……*rufibasis*

Simulium tobetsuense ONO

[Japanese name : Ezo-hime-ashimadara-buyu]

Simulium tobetsuensis ONO, 1977, *Jap. J. Sanit. Zool.*, 28 (3) : 263-271 (female, male, pupa, larva).

Simulium (Simulium) venustum, KUWAYAMA, 1967, Ins. Fauna S. Kuril Islands, 110.

Simulium (Simulium) venustum, ONO, 1970, *Res. Bull. Obihiro Univ.*, 6 : 334 361, 362 367.

Holotype Female, in the Laboratory of Entomology, Obihiro University.

Type locality Makubetsu, Nakagawa, Hokkaido; The Tobetsu River at Satsunai, June 2, 1974 (H. ONO).

Distribution Hokkaido (Tokachi, Kushiro, Nemuro); Kurile Islands (Kunashiri), Sakhalin, Far East.

Biological notes A large number of pupae attached on submerged vegetation were found during the period from June to October, the prevalence has two peaks, one being in July, the other in September. The larvae were found during the period from April to November, but absent from December to March. Therefore, this species is thought to be bivoltine and probably overwinters in the egg stage. The eggs hatched in late March or early April and the fist appearance of the adults was in late May. The larvae and pupae were found abundantly in sandy and slowly meandering streams of plain rivers and rarely in highland ones. They are found attached to trailing grasses and roots, especially on the reeds. Sometimes the males swarm in the evening about 1.5–2.5 m above the ground over small shrubs at the grass land near the stream. Biting habits are unknown. Mermithid nematodes often heavily parasitize this species larvae (ONO, unpublished data).

Simulium arakawae MATSUMURA

[Japanese name: Hime-ashimadara-buyu]

Simulium arakawae MATSUMURA, 1921, Dai Nippon Gaichu Zensho. II. p. 85 (female).

Simulium arakawae, BENTINCK, 1955, 406 MGL U. S. Army, pp. 23, Fig. 1–33 (female, male, pupa).

Simulium arakawae, RUBTSOV, 1959–1964, Simuliidae, 558–559 (female, male, pupa).

Simulium arakawae, ONO, 1977, *Jap. J. Sanit. Zool.*, 28 (3): 263–271 (female, male, pupa, larva).

Simulium (Simulium) arakawae, ORII, UEMOTO and ONISHI, 1969, *Sanit. Injur. Ins.*, 13 (1): 1–13 (larva).

Simulium (Simulium) arakawae, TAKAOKA, 1977, *Jap. J. Sanit. Zool.*, 28 (2): 193–217 (female, male, pupa, larva).

Simulium nipponese SHIRAKI, 1935, *Memo. Fac. Agr. Taihoku Imp. Univ.*, 16 (1): 59–70, pl. II, fig. 6; XIII, figs. 1–6 (female).

Simulium venustum (nec. SAY), TAKAHASI, 1950, Icong. Ins. Jap. 1559 (female, male).

Simulium (Simulium) venustum, OGATA, 1954, *Appl. Zool.*, 19 (3): 136–141.

Simulium (Simulium) venustum, OGATA and SASA, 1955, *Jap. J. Sanit. Zool.*, 6 (1): 10–18.

Simulium (Simulium) venustum, OGATA, SASA and SUZUKI, 1956, The Japanese Black Flies and their control. pp. 166 (female, pupa, larva).

Syntype Female, in the Entomological Institute, Faculty of Agriculture, Hokkaido University.

Type locality Sapporo, Hokkaido, Maruyama, May 23, 1916 (S. MATSUMURA).

Distribution Hokkaido (western Hokkaido, Shiribeshi, Ishikari, Sorachi, Iburi, Rumoi), Honshu, Shikoku, Kyushu, the Nansei Islands: Korea.

Biological notes Pupae and larvae were attached to trailing grasses, dead leaves and sticks in the lowland streams varying from about 20 cm to about 6 m in width. The larvae and pupae were found during the period from May to September in Western Hokkaido, often togenther with larvae of *Cnetha uchidai*, *Gomphostilbia shogakii* and *Odagmia aokii*. Females of this species have been reported to bite man, horses, cattle and goats (OGATA, 1955).

Simulium japonicum MATSUMURA

[Japanese name: Ashimadara-buyu]

Simulium japonicum MATSUMURA 1931, 6,000 Illustr. Ins. Jap. 407 (female).

Simulium japonicum, TAKAHASI, 1941, *Ins. Matsum.*, 15: 86–88.

Simulium japonicum, TAKAHASI, 1950, Icong. Ins. Jap., 1558 (female, male).

Simulium japonicum, TAKAHASI, 1959, Illust. Ins. Larvae Jap., 636 (pupa, larva).

Simulium japonicum, BENTINCK, 1955, 406 MGL U. S. Army, pp. 23, Figs. 1–33 (female, male, pupa).

Simulium japonicum, RUBTSOV, 1959–1964, Simuliidae, 540–541 (female, male, pupa).

Simulium (Simulium) japonicum, TOKUNAGA, 1943, Med. Ent., 964.

Simulium (Simulium) japonicum, OGATA and SASA, 1954, *Jap. J. Exp. Med.*, 24 : 325–333.

Simulium (Simulium) japonicum, OGATA and SASA, 1955, *Jap. J. Sanit. Zool.*, 6 : 10–18.

Simulium (Simulium) japonicum, OGATA, SASA and SUZUKI, 1956, The Japnese Black Flies and their control. pp. 166 (female, pupa, larva).

Simulium (Simulium) japonicum, OGATA, 1956, *Jap. J. Med. Sci. Biol.*, 9 : 59–69.

Simulium (Simulium) japonicum, OGATA, 1966, *Kontyu*, 34 : 123–130.

Simulium (Simulium) japonicum, ORII, UEMOTO and ONISHI, 1969, *Sanit. Injur. Ins.*, 13 (1) : 1–13 (larva).

Simulium (Simulium) japonicum, KUWAYAMA, 1967, Ins, Fauna S. Kurile Islands. 110.

Simulium (Simulium) japonicum, TAKAOKA, 1974, *Jap. J. Sanit. Zool.*, 25 (2) : 141–146.

Simulium (Simulium) japonicum, TAKAOKA, 1977, *Jap. J. Sanit. Zool.*, 28 (2) : 201–205 (female, male, pupa, larva).

Simulium oshimanum SHIRAKI, 1935, *Mem. Fac. Sci. Agr. Taihoku Imp. Uni.*, 16 : 1–90 (female).

Syntype Female, in the Entomological Institute, Faculty of Agriculture, Hokkaido University.

Type locality Sapporo, Hokkaido : Maruyama, May 23, 1916 (S. MATSUMURA).

Distribution Hokkaido (widely destributed in Hokkaido, including Rishiri and Rebun Islands), Honshu, Shikoku, Kyushu and the Nansei Islands : Sakhalin, Kurile Is., Korea, Far East.

Biological notes It is the commonest species and widely distributed in Hokkaido. Larvae and pupae are found on various types of substratum, mostly from the surface of rocks and stones in swift streams and cascades in mountainous regions. Young larvae, full grown ones and pupae are found during the period from September to late April, from late March to late May and from April to May, respectively. Females of the present species were already known to bite man and domestic animals (OGATA, 1955, 1956). In the Nansei Islands, TAKAOKA (1977) observed that females of the present species are severe biters of man and cattle and also, although less frequently, goats, cats, pigs, and chickens throughout the year. But in Hokkaido, the author observed that females were severe biters of man, cattle and horses only in late Spring to early Summer. Mermithid nematodes often heavily parasitize this species (ONO, unpublished data).

Simulium horokaense ONO

[Japanese name : Horoka-ashimadara-buyu]

Simulium horokaense ONO, 1980, *Kontyu*, 48 (3) : 333–361 (female, male, pupa, larva).

Holotype Female, in the Laboratory of Entomology, Obihiro Univ.

Type locality Nukabira, Kamishihoro, Hokkaido ; Go no sawa, in the forest, August 25, 1977 (H. ONO).

Distribution Hokkaido (Eastern Daisetsu National Park).

Biological notes The larvae of this species were found in considerably rapid streams (altitude, about 600–900 m). The streams were situated in a considerably broad, rather gravel-bottomed, and well shaded by a mixed forest cover. The larvae were most common in the currents and they were found on the upperside of stones in swarming young stage, and on the underside of grass blades, dead leaves and other debris in mature stage. Crowded pupae were usually found on the undersides of sasa leaves or sticks that were trailing at small falls or sharp turn points in the streams, occasionally found on the underside of large stones at the upper or lower sides of small falls. This species is considered to be univoltine and overwinters in the egg stage. The eggs hatch in early May and the first adults appear in late July. Massess of adults are found from early August to early September near the considerably rapidly running streams of the forest. Young larvae of this species are found in company with full grown larvae of *Simulium japonicum* and *Distosimulium daisetsense* from May to June, but by contrast full grown larvae of this species are found together with young larvae

of *S. japonicum* and *Prosimulium jezonicum* from August to September. Serious biting habit to man on near streams has been observed (ONO, unpublished data).

Simulium nikkoense SHIRAKI

[Japanese name: Kuro ashimadara-buyu]

Simulium nikkoense SHIRAKI, 1935, *Mem. Fac. Agr. Taihoku Imp. Univ.*, 16: 1-90 (female).

Simulium (Simulium) nikkoense, TOKUNAGA, 1943, Med. Ent., 964.

Simulium noelleri, TAKAHASI, 1950, Icong. Ins. Jap., 1558 (female, male).

Simulium (Simulium) decorum, OGATA and SASA, 1955, *Jap. J. Sanit. Zool.*, 6: 10-18.

Simulium (Simulium) decorum, OGATA, SASA and SUZUKI, 1956, The Japanese Black Flies and their control. pp. 166 (female, pupa, larva).

Simulium decorum, BENTINCK, 1955, 406 MGL U. S. Army, pp. 23, Figs. 1-33 (female, male, pupa).

Simulium decorum, TAKAHASI, 1959, Illust. Ins. Larvae Jap., 636 (pupa, larva).

Simulium argyreatum triangulare RUBTSOV, 1959-1964, Simuliidae, 558 (female, male, pupa).

Simulium (Simulium) decorum, ORII, UEMOTO and ONISHI, 1969, *Sanit. Injur. Ins.*, 13 (1): 1-13 (larva).

Holotype Female, in Entomological Museum of the Goverment Research Institute, Taihoku, Formosa.

Type locality Nikko, Tochigi Prefecture, July 3, 1911 (T. SHIRAKI).

Distribution Hokkaido (Oshima, Hiyama, Ishikari, Sorachi, Kamikawa), Honshu, Shikoku, Kyushu: Korea.

Biological notes This species has been taken only rarely, breeding in lowland streams in the months June through September in Hokkaido. Host preference is unknown but a captive female was induced to bite and took a complete blood meal from a man (BENTINCK, 1955).

Simulium suzukii RUBTSOV

[Japanese name: Suzuki-ashimadara-buyu]

Simulium suzukii RUBTSOV, 1962, Simuliidae, 525-526 (female, male).

Simulium (Simulium) suzukii, ORII, UEMOTO, and ONISHI, 1969, *Sanit. Injur. Ins.*, 13 (1): 1-13 (larvae).

Simulium (Simulium) suzukii, TAKAOKA, 1977, *Jap. J. Sanit. Zool.*, 28 (2): 193-217 (female, male, pupa,

Simulium tuberosum (nec LUNDSTROM), TAKAHASI, 1959, Illust. Ins. Larvae Jap., 637 (pupa, larva).

Simulium tuberosum, BENTINCK, 1955, 406 MGL U. S. Army, pp. 23, Figs. 1-33 (female, male).

Simulium (Simulium) tuberosum, OGATA and SASA, 1955, *Jap. J. Sanit. Zool.*, 6: 10-18.

Simulium (Simulium) tuberosum, OGATA, SASA and SUZUKI, 1956, The Japanese Black Flies and their contral. pp. 166 (female, pupa, larva).

Simulium (Simulium) ryukyuense OGATA, 1966, *Kontyu*, 34: 123-130.

Holotype Female (location not known to the author).

Type locality Japan, detailed data not known to the author.

Distribution Hokkaido (southern and central Hokkaido in low land region, Oshima, Hiyama, Shiribeshi, Ishikari, Sorachi, Kamikawa), Honshu, Kyushu and the Nansei Islands: Korea.

Biological notes Larvae and pupae are found from trailing grasses, sticks and artificial debris in considerably rapid streams. Biting habit of this species has not been observed although biting collections have been made on man and cattle in the Nansei Islands (TAKAOKA, 1977). However, in other localities of Japan, females of *S. suzukii* have been reported to attack man severely (OGATA, 1955). In southern Hokkaido, females of *S. suzukii* have been observed to attack man and to bite man severely in the evenings of late August (ONO, unpublished data).

Simulium rufibasis BRUNETTI

[Japanese name: Akakura-ashimadara-buyu]

Simulium rufibasis BRUNETTI, 1911, *Rec. Indian Mus.*, 4: 283-288 (female).

Simulium rufibasis, RUBTSOV, 1959-1964, Simuliidae, 554-555 (female, male).

Simulium (Simulium) rufibasis, PURI, 1932, *Indian J. Med. Red.*, 19 : 899–917.

Simulium (Simulium) rufibasis, OGATA, SASA and SUZUKI, 1956, The Japanese Black Flies and their control. pp. 166 (female, pupa, larva).

Simulium (Simulium) rufibasis, ORII, UEMOTO and ONISHI, 1969, *Sanit. Injur. Ins.*, 13 (1) 1–13 (larva).

Simulium (Simulium) rufibasis, TAKAOKA, 1977, *Jap. J. Sanit. Zool.*, 28 (2) : 193–217 (female, male, pupa, larva).

Simulium J 5, BENTINCK, 1955, 406 MGL. U. S. Army, pp. 23, Figs. 1–33 (female, male).

Holotype Female (location not known to the author).

Type locality Kurseong, Darjeeling, India (E. BRUNETTI).

Distribution Hokkaido (western Hokkaido, Shiribeshi, Ishikari, Sorachi, Iburi), Honshu, Shikoku, Kyushu and the Nansei Islands : Korea, India.

Biological notes Larvae and pupae are found from trailing grasses, sticks and dead leaves in swift mountain streams. Often, *S. suzukii* was collected together with this species. It has been reported that females of *S. rufibasis* bite man (BENTINCK, 1955 : OGATA et al., 1956) and goats (OGATA et al., 1956). In southern Hokkaido, females of *S. rufibasis* have rarely been observed to attack man but will clearly bite man in the evenings of late August (ONO, unpublished data).

The list of Simuliidae of Hokkaido

Family Simuliidae NEWAMAN, 1834 ブユ科

Subfamily Gymnopaidinae RUBTSOV, 1956 クロオオブユ亜科

Genus *Twinnia* STONE and JAMNBACK, 1955 クロオオブユ属

1. *Twinnia canivora* ONO, 1977 キタクロオオブユ
2. *Twinnia subtibbelesi* ONO, 1980 エゾクロオオブユ

Subfamily Prosimuliinae SMART, 1945 オオブユ亜科

Tribe Helodoini trib. n. ハイイロオオブユ族

Genus *Helodon* ENDERLEIN, 1921 ハイイロオオブユ属

3. *Helodon multicaulis* (POPOV, 1968) ハイイロオオブユ

Tribe Prosimuliini STONE, 1964 オオブユ族

Genus *Distosimulium* PETERSON, 1970 ムカシオオブユ属

4. *Distosimulium daisetsense* UEMOTO, OKAZAWA and ONISHI, 1976 ムカシオオブユ

Genus *Prosimulium* ROUBAUD, 1906 オオブユ属

5. *Prosimulium jezonicum* MATSUMURA, 1931 オオブユ
6. *Prosimulium yezoense* SHIRAKI, 1935 キアシオオブユ
7. *Prosimulium karibaense* ONO, 1980 キンイロオオブユ
8. *Prosimulium sarurense* ONO, 1976 サルルキアシオオブユ
9. *Prosimulium apoinum* ONO, 1977 アポイキアシオオブユ

Subfamily Cnephiinae GRENIER et RAGEAU, 1960 ハルブユ亜科

Genus *Stegopterna* ENDERLEIN, 1930 ハルブユ属

10. *Stegopterna nukabirana* ONO, 1977 ダイセツハルブユ

Subfamily Simuliinae SMART, 1945 ブユ亜科

Tribe Eusimuliini RUBTSOV, 1974 ツノマユブユ族

Genus *Eusimulium* ROUBAUD, 1906 オオツノマユブユ属

11. *Eusimulium erimoense* ONO, 1980 エリモツノマユブユ

Genus *Montisimulium* RUBTSOV, 1974 ミヤマブユ属

12. *Montisimulium sakhalinum* (RUBTSOV, 1962) カラフトミヤマブユ

Genus *Gomphostilbia* ENDERLEIN, 1921 クジツノマユブユ属

13. *Gomphostilbia shogakii* (RUBTSOV, 1962) クジツノマユブユ

Genus *Cnetha* ENDERLEIN, 1921 ツノマユブユ属

14. *Cnetha subcostatum* (TAKAHASI, 1950) オタルツノマユブユ
15. *Cnetha boldstemtum* ONO, 1978

オビヒロツノマユブユ

16.*Cnetha uchidai* (TAKAHASI, 1950)

ウチダツノマユブユ

17.*Cnetha acmerium* ONO, 1978

サツナイツノマユブユ

18.*Cnetha konoi* (TAKAHASI, 1950)

コウノホソスネブユ

19.*Cnetha rebunense* ONO, 1979

レブンホソスネブユ

Tribe Simuliini GRENIER et RAGEAU, 1960 ブユ族

Genus *Boophthora* ENDERLEIN, 1921

ツヤガシラブユ属

20.*Boophthora yonagoense makunbei* ONO, 1977 ツヤガシラブユ

Genus *Gnus* RUBTSOV, 1940 ヤマブユ属

21.*Gnus daisense* TAKAHASI, 1950

ダイセンヤマブユ

22.*Gnus fulvipes* ONO, 1978

オシマヤマブユ

Genus *Odagmia* ENDERLEIN, 1921

ツメトゲブユ属

23.*Odagmia aokii* TAKAHASI, 1941

アオキツメトゲブユ

24.*Odagmia nishijimai* ONO, 1978

ニシジマツメトゲブユ

Genus *Simulium* LATREILLE, 1802 ブユ属

25.*Simulium tobetsuense* ONO, 1977

エゾヒメアシマダラブユ

26.*Simulium arakawae* MATSUMURA, 1931

ヒメアシマダラブユ

27.*Simulium japonicum* MATSUMURA, 1931

アシマダラブユ

28.*Simulium horokaense* ONO, 1980

ホロカアシマダラブユ

29.*Simulium nikkoense* SHIRAKI, 1935

クロアシマダラブユ

30.*Simulium suzukii* RUBTSOV, 1962

スズキアシマダラブユ

31.*Simulium rufibasis* BRUNETTI, 1911

アカクラアシマダラブユ

IV. BIOLOGICAL STUDY IN RELATION TO VETERINARY MEDICINE

a) Materials and Methods

The materials used in this paper were collected throughout Hokkaido including Rishiri and Rebun isles. The field work was carried out mainly from 1970 to 1979, and several methods were employed in studying the distribution of the aquatic stages in both time and space. The simuliid larvae and pupae of all 31 species were collected from many trickles, rivulets, streams and rivers in Hokkaido. The larvae and pupae were reared in the laboratory. Females and males were obtained by rearing and field collecting work.

Especially, females of Simuliidae were collected and observed to bite man and domestic animals, being an annoying species of medical and veterinary importance from Hokkaido.

b) General habit of black flies

Oviposition and *Hatching* :

In some species the first oviposition may be before a blood meal, and subsequent ones will be made following blood feeding. The eggs of some species are laid in masses on floating vegetation or rocks under the water, and others scattered singly dropping to the bottom of the stream bed. They hatch in a few days, but some of them overwinter for seven months or more.

Larval Habitat :

The simuliid species are always aquatic in the immature stages, and the larvae require running water for their development. Most of them need a slow or fast steady current. They are found in all types of watercouses from the merest temporary trickles to great rivers, though each species tends to prefer one particular type of water habitat. They are filter feeders and use their cephalic fans to strain fine paticulate matter from the water, ingesting the filtrate and using the organic element in it as food. Their predominant foods are found to be algae of various kinds, especially diatoms; rotifer eggs, desmids and fragments of vegetable debris also occur in the gut contents (MAITLAND, 1966; CROSSKEY, 1973; PETERSON, 1956). Therefore, feeding habits are considered to be omnivorous. Black-fly larvae are

Table I. Larval habits of simuliids in Hokkaido

Simulid species	Nature of stream		Place of attachment	Main period of occurrance	Altitude (m)
	flowing condition	stream-bed			
Twinnia canivora	slow	gravel	stone surface	May to June	600-1,200
T. subtibbelesi	slow	sand	submerged vegetation	March to April	40-50
Helodon multicaulis	rapid	gravel	stone surface	May to July	800-900
Distosimulium daisetsense	rapid	gravel	stone surface	May to June	500-1,500
Prosimulium jezonicum	rapid	stone	stone surface	Sep. to May	40-900
P. yezoense	rapid	gravel	trailing vegetation	May to June	300-600
P. karibaense	rapid	stone	stone surface	May to June	600-1,500
P. sarurense	rapid	gravel	stone surface	May to June	200-600
P. apoinum	rapid	gravel	stone surface	May to June	10-400
Stegopterna nukabirana	slow	sand	submerged vegetation	May to June	600-900
Eusimulium crinocense	slow	sand	trailing vegetation	March to April	10-300
Montisimulium sakhalianum	slow	sand	submerged vegetation	May to July	600-1,800
Gomphostilbia shogakii	slow	gravel	trailing vegetation	May to June	10-40
Cnetha subcostatum	slow	sand	submerged vegetation	March to Oct.	40-900
C. boldstemtum	slow	sand	submerged vegetation	Feb. to May	40-50
C. uchidai	slow	sand	trailing vegetation	May to Oct.	30-1,500
C. aomerium	rapid	sand	submerged vegetation	Feb. to May	40-50
C. konoi	slow	gravel	trailing vegetation	May to Oct.	40-900
C. rebunense	slow	sand	trailing vegetation	June to July	5-40
Boophthora yonagoense	rapid	sand	trailing vegetation	May to Oct.	40-50
Gnus daisense	rapid	gravel	stone surface	June to Sept.	40-900
G. fulvipes	rapid	gravel	submerged vegetation	May to June	300-600
Odagmia aokii	slow	gravel	trailing vegetation	May to Oct.	300-600
O. nishijimai	slow	sand	submerged vegetation	May to Oct.	40-300
Simulium tobetsuense	slow	sand	trailing vegetation	May to Oct.	40-300
S. arakawae	slow	sand	trailing vegetation	May to Sept.	20-60
S. japonicum	rapid	gravel	trailing vegetation	Sep. to May	40-900
S. horokaense	rapid	gravel	trailing vegetation	June to August	600-900
S. nikkoense	rapid	gravel	trailing vegetation	May to August	30-300
S. suzukii	rapid	gravel	trailing vegetation	May to August	30-300
S. rufibasis	rapid	gravel	trailing vegetation	May to August	30-300

sometimes predaceous and may ingest small chironomid larvae or indulge in cannibalism, swallowing the very young instars of their own kind (CROSSKEY, 1973). There are a few aberrant forms (species of *Twinnia*) in which the cephalic fans are absent, feeding then being accomplished by scraping algal matter. The cannibalism of *Twinnia* larvae was reported by the author (1977e). Known larval habits of simuliids in Hokkaido are summarized in Table I.

Cocoon Spining :

When the larvae mature, they spin various types of cocoons and pupate with head pointed downstreams. These cocoons may be of only a few threads, a loose mass of webbing or in a definite shape characteristic for the species. The pupae are held in the cocoon by means of spines or hooks on the abdomen and the respiratory filaments on the thorax usually protrude from the front of the cocoon. The pupal stage lasts

Table Ⅱ. Distribution of the black flies in each district and island of Hokkaido.

Simuliid species	District													Island	
	Oshima	Hiyama	Shiribeshi	Ishikari	Sorachi	Iburi	Hidaka	Rumoi	Kamikawa	Soya	Abashiri	Tokachi	Kushiro	Nemuro	Rishiri	Rebun
Twinnia canivora			+		−		−		−			+		+		
T. subtibbelesi												+				
Helodon multicaulis				+			+		+			+		+		
Distosimulium daisetsense							+		+		+	+		+		
Prosimulium jezonicum	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
P. yezoense				+	+				+		+	+	+	+		
P. karibaense	+	+					+									
P. sarurense							+					+				
P. apoinum							+									
Stegopterna nukabirana							+		+		+	+		+		
Eusimulium erimoense							+									
Montisimulium sakhalinum					+				+			+		+		
Gomphostilbia shogakii	+	+	+			+										
Cnetha subcostatum	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
C. uchidai	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
C. konoi	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
C. boldstemtum												+				
C. acmerum												+				
C. rebunense																+
Boophthora yonagoense												+				
Gnus daisense												+				
G. fulvipes	+	+														
Odagmia aokii			+	+	+	+		+								
O. nishijimai												+	+	+		
Simulium tobetsuense												+	+	+		
S. arakawae			+	+	+	+		+								
S. japonicum	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
S. horokaense									+			+				
S. nikkoense	+	+		+	+				+							
S. suzukii	+	+	+	+	+				+							
S. rufibasis			+	+	+	+										

from four days to a week or more, depending on the temperature of the water.

Emergence and *Mating* :

The adults of most species emerge from the pupal skin in a bubble of gas, and are able to fly immediately on reaching the water surface. In the natural habitat emerging adults of black flies are observed to take flight almost immediately upon reaching the surface of the water, but soon land to rest and dry.

Mating varies with the species, some species forming male mating swarms, the females being recognized visually, whereas others mate over the water surface by accidental contact, males staying on the surface of leaves which are over the stream to wait until females emerge.

c) Geographical distribution and habitat segregation

Table Ⅲ. Geographical distribution of the black flies found in Hokkaido

Simulid species	JAPAN					OTHER CONTRIES				
	Hokkaido	Honshu	Kyushu	Shikoku	Nansei Isls	Korea	Manchuria	U. S. S. R	Sakhalin	Kuril Isls.
Twinnia canivora	+									
T. subtibbelesi	+									
Helodon multicaulis	+						+	+		
Distosimulium daisetsense	+									
Prosimulium jezonicum	+	+					+	+	+	
P. yesoense	+	+	+						+	
P. karibaense	+									
P. sarurense	+									
P. apoinum	+									
Stegopterna nakabiyana	−									
Eusimulium erimoense	−									
Montisimulium sakhalinum	−								+	
Gomphostilbia shogakii	+	+	+	+		+		−		
Cnetha subcostatum	−	+	+	+	+	+		+		
C. uchidai	−	+	+	+	+	+	+	+		
C. konoi	−	+						+		
C. boldstemtum	−									
C. acmerium	+									
C. rebunense	+									
Boophthora yonagoense	+	−		−						
Gnus daisense	+	−	−	−						
G. fulvipes	+									
Odagmia aokii	+	+	+	+	−	+				
O. nishijimai	+									−
Simulium tobetsuense	+							+	−	−
S. arakawae	+	+	+	+	+	+				
S. japonicum	+	+	+		+	+		+	+	+
S. horokaense	+									
S. nikkoense	+	+	+	+		+				
S. suzukii	+	+	+		+	+				
S. rufibasis	+	+	+	+	+	+				

of the black flies in Hokkaido

Up to the present, a total of 59 simuliid species have been recorded from Japan. Among these only 31 species are found in Hokkaido. Table II shows the distribution of the black flies in each district and on the island of Hokkaido. As shown in Table II, *P. jezonicum*, *C. subcostatum*, *C. uchidai*, *C. konoi* and *S. japonicum* are widely distributed over the whole of Hokkaido. *S. nikkoense*, *S. suzukii* and *S. rufibasis* are found only in the south-western part of Hokkaido, while *O. nishijimai* and *S. tobetsuense* are, on the contrary, recorded only from eastern Hokkaido.

Table III shows the geographical distribution of the black flies found in Hokkaido. At present, the species recorded only in Hokkaido are as follows: *T.*

Table IV. Habitat segregation of the blac.. nies in Hokkaido

Simuliid species	Elevation of stream			Characters of stream *				
	Upland	Semi upland	Low land	Rivulets	Rills and ditches	Small streams	Medium streams	Wide streams
Twinnia canivora	+ −	+		+ +		+		
T. subtibbelesi			+ + +	+ +		+		
Helodon multicandis	+ + −			+		+	+	
Distosimulium daisetsense	+ + −					− +	+	
Prosimulium jezonicum	+	+	+			+	+	+
P. yezoense		+	+ +			+	+	+
P. karibaense	+ +	+		+		+ +		
P. sarurense		+ +	+			+	+	+
P. apoinum		+ +	+			−	+	+
Stegopterna nukabirana	− + +			− +	+			
Eusimulium erimoense		+	+ ·		+	+ +		
Montisimulium sakhalinum	+ + +			+ + −				
Gomphostilbia shogakii			+ + +			− + +		
Cnetha subcostatum	+	+	+	−	+	+		
C. uchidai	+	+	+	−	+	+		
C. konoi	+	· +			+	+	−	
C. boldstemtum			+ + −	+ + +				
C. acmerium			+ + −	− + +				
C. rebunense			+ + −				+ + +	
Boophthora yonagoense			+ + −		+ +	+		
Gnus daisense	−	+ +				+	+	+
G. fulvipes		+	+ +		−	+	+	
Odagmia aokii			+ − +			−	+	−
O. nishijimai		−	+ +		+ +	·		
Simulium tobetsuense			+ − +		+	−	+	
S. arakawae			+ + +		+	−	+	
S. japonicum	+	+ +				−	− +	
S. horokaense	+ +	−				+ +	+	
S. nikkoense		+	+ +			+ +	+	
S. suzukii		+	+ ·			+	+	+
S. rufibasis		+	+ +			+	+	+

* cf. Table I.

canivora, *T. subtibbelesi*, *D. daisetsense*, *P. karibaense*, *P. sarurense*, *P. apoinum*, *S. nukabirana*, *E. erimoense*, *C. boldstemtum*, *C. acmerium*, *C. rebunense*, *G. fulvipes*.

Larval and pupal habitat segregation of these 31 spehies are noted with elevation and characteristics of streams as shown in Table IV. The different habitats studied may be grouped into three major categories, dependent chiefly upon elevation as follows:

Upland : The study location above the critical elevation, or without regard to elevation, the water from the major area of watershed coming from springs.

Semi-upland : The study location below, but major area of watershed above the critical elevation.

Low land : The study location and the major area of watershed below the critical elevation.

From the point of view of their width, streams may be divided as follows :

1. Rivulets of a temporary nature, up to 0.01–0.5 m wide, where *Twinnia canivora*, *Montisimulium sakhalinum*, *Cnetha boldstemtum*, *C. acmerium* breed.

2. Rills and ditches of a artifical current, up to 0.3–1.0 m wide, where *Boophthora yonagoense*, *Odagmia nishijimai* breed.

3. Small streams of 0.5–1.0 m wide, where *Gomphostilbia shogakii*, *Cnetha uchidai*, *C. subcostatum* breed.

4. Medium-sized streams of 1–3 m wide, inhabited by *C. rebunense*, *S. japonicum*.

5. Wide streams over 3 m, where several species of Genus *Prosimulium* and Genus *Simulium* occur.

d) Biting habits and the relationship to veterinary medicine

Black flies have recently begun to be intensively investigated because of their role as bloodsuckers and transmitters of diseases in various parts of the world (ANDERSON et al., 1961, 1963 ; CARLSSON, 1962 ; FREDEEN, 1956 ; JAMNBACK, 1973 ; PETERSON, 1956, 1962, 1970a, b, 1977a, b ; RUBTSOV, 1957, 1959–1964 ; SHEWELL, 1952, 1958, 1959 ; SOMMERMAN et al., 1955 ; STONE, 1964 ; ZWICK, 1974). Although the females of most species are bloodsuckers, there are some that are not. The great majority of them bite and suck the blood of warm-blooded vertebrates. As a consequence of this feeding habit black flies are able to transmit several pathogenic organisms, and some species are incriminated as vectors of skin-inhabiting filarial nematodes of the genus *Onchocerca* DIESING in mammals including man and of protozoan blood parasites of the genus *Leucocytozoon* ZIEMANN among birds (BLACKLOCK, 1926 ; CRISP, 1956 ; CROSSKEY, 1973 ; DALMAT, 1955) ; they are considered to be natural vectors of avian typanosomes (BENNETT, 1961). Viruses have been isolated from some ornithophilic black flies are reputed to be involved in the transmission of myxomatosis virus among Australian rabbits (MYKYTOWYCZ, 1957). Black flies are also known to transmit eastern equine encephalitis virus, vesicular stomatitis virus and filarial nematode, *Setraia equina*, that infests horses (ANDERSON et al., 1961 ; FERRIS et al., 1955). Apart from their role as transmitters of human, bovine, equine and avian diseases the black flies can have very serious and harmful effects on man and domestic animals because of their severe biting attacks, especially at times when mass outbreaks occur or when seasonal abundance is at its peak. They may then have a deleterious economic effect on, for instance, the lumbering and tourist industries, on the health and milk or meat-yield of livestock, or on the egg laying of poutry. Certain species may occur at times in enormous numbers and their bites produce and their bites produce an allergic reaction that may be very severe in man and cause the death of many domestic and wild mammals. Some people react very severely to relatively few bites. Even when the black flies do not bite they can be very annoying by getting into eyes, ears and nostrils.

The host preference of most of the species of black flies are not well known, but a number of black fly species are known to bite man, horses, mules, cattle, sheep, goats, pigs, brown bears, squirrels, turkeys, ducks, chickens and other animals. Another interesting biting habit was noted by PETERSON (1956), who found a species of Simulium feeding upon ants. The other records of feeding upon the chrysalids of butterfly, *Neophasis menapia* FLEDER and caterpillars of moth, *Smerinthus planus* WALK, imago of moth, *Stauropus fagi persimilis* BUTL., have been noted by HAGEN (1883), JOBBINS-POMEROY (1887) and EMERY (1913), but those records seem to be doubtful, because no such observation has been reported after their publications.

In Japan, the biting habits of simuliids have been investigated in Honhsu, Kyushu and the Nansei Is-

lands (BENTINCK, 1955; OGATA et al., 1956; TAKAHASI, 1950; TAKAOKA, 1977b). In Hokkaido, these habits have been insufficiently investigated (MATSUMURA, 1921, 1931; SHIRAKI, 1935; TAKAHASI, 1950, 1959), but the author observed that species that attack man are *Prosimulium jezonicum*, *Odagmia aokii*, *Odagmia nishijimai* in late Spring, *Prosimulium yezoense*, *P. apoinum*, *P. karibaense*, *Simulium arakawae*, *S. japonicum* in early summer, *S. horokaense*, *S. suzukii*, *S. rufibasis* in late summer and early autumn. *Twinnia canivora and Stegopterna nukabirana* rarely bite at high altitudes, and *S. nikkoense* rarely at low altitudes. Even though some species of black flies rarely or never bite man, they may, nevertheless be very pestiferous.

According to the author's observation, the species of black flies that mainly attack cattle and horses in the meadows and pastures are as follows: *Prosimulium jezonicum*, *P. yezoense*, *Odagmia aokii*, *Simulium arakawae*, *S. japonicum*, *S. suzukii* and *S. rufibasis*. Especially, the great numbers of females of *S. japonicum* are found flying about the body of horses and cattle, and biting near the ears and nipple in early summer. *Gnus daisense* was found flying

Table V. Known host animals of simuliids in Hokkaido.

Simuliid species	Vertebrate host	Main references
Twinnia canivora	Man	ONO, 1977e
T. subtibbelesi	(Unknown)	ONO, 1980b
Helodon multicaulis	(Unknown)	ONO, 1976b
Distosimulium daisetsese	(Unknown)	UEMOTA et al., 1976
Prosimulium jezonicum	Man, horse, cattle	OGATA et al., 1956
P. yezoense	Man, horse, cattle	OGATA et al., 1956
P. karibaense	Man	ONO, 1980a
P. sarurense	(Unknown)	ONO, 1976a
P. apoinum	Man	ONO, 1977f
Stegopterna nukabirana	Man	ONO, 1977a
Eusimulium erimoense	(Unknown)	ONO, 1980b
Montisimulium sakhalinum	(Unknown)	ONO, 1977c
Gomphostibia shogakii	(Unknown)	OGATA et al., 1956
Cnetha subcostatum	(Unknown)	OGATA et al., 1956
C. boldstemtum	(Unknown)	ONO, 1978b
C. uchidai	(Unknown)	TAKAOKA, 1976a
C. acmerium	(Unknown)	ONO, 1978b
C. konoi	(Unknown)	ONO, 1979
C. rebunense	(Unknown)	ONO, 1979
Boophthora yonagoense	(Unknown)	OKAMOTO, 1958
Gnus daisense	Goat	ONO, 1976b
G. fulvipes	(Unknown)	ONO, 1978c
Odagmia aokii	Man, horse, cattle	OGATA et al., 1956
O. nishijimai	Man	ONO, 1978a
Simulium tobetsuense	(Unknown)	ONO, 1977b
S. arakawae	Man, horse, cattle	BENTINCK, 1955
S. japonicum	Man, horse, cattle, pig, goat, cat and chicken	TAKAOKA, 1977a
S. horokaense	Man	ONO, 1980b
S. nikkoense	Horse, cattle, man ?	OGATA et al.,1956
S. suzukii	Man, horse, cattle	BENTINCK, 1955
S. rufibasis	Man, horse, cattle, goat	OGATA, et al., 1956

about the body of goat, rarely biting, but not attacking man or cattle at Kamishihoro (ONO, unpublished data). Known host animals of simuliids in Hokkaido are summarized in Table V.

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摘　　要

北海道産ブユ類の分類学的研究および獣医学との関連性について

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著者は1970年以来北海道におけるブユの分類学的研究を行なうため各地で多数の材料を採集飼育し，更にその害性特に吸血性について獣医学との関係を検討した。それらを要約すれば下記の通りである。

1）北海道で1976年までに12種のブユが知られていたが，著者の調査により更に19種のブユが追加され，現在計31種のブユが北海道に産することが確認された。その19種の内訳は14新種，1新亜種が著者によって記載され，日本未記録2種が再記載され，北海道未記録2種が報告されている。

2）分類学上，ハルブユ亜科，ハイイロオオブユ族を新らたに創設した。

3）家畜に来襲吸血する種名の確認されたブユは次の通りである（表V参照）：

オオブユ，キアシオオブユ，アオキツメトゲブユ，アシマダラブユ，ヒメアシマダラブユ，クロアシマ

ダラブユ，スズキアシマダラブユ，アカクラアシマダラブユ。この内アシマダラブユはその最盛期（6月上，中旬）に放牧中の牛馬にはげしく来襲吸血する最も重要な種である。

4）ダイセンヤマブユは山羊に来襲吸血することが観察されたが，牛馬，人体に来襲することは観察されていない。

5）人体に来襲吸血する種名の確認されたブユは次の通りである（表V参照）：

オオブユ，アオキツメトゲブユ，ニシジマツメトゲブユ——晩春。キアシオオブユ，キンイロオオブユ，アポイキアシオオブユ，アシマダラブユ，ヒメアシマダラブユ——初夏。ホロカアシマダラブユ，スズキアシマダラブユ，アカクラアシマダラブユ——晩夏，初秋。この内アシマダラブユは発生量が多く最もはげしく人体に来襲吸血する。

6）キタクロオオブユ，ダイセツハルブユは高山地帯で群飛するが人体から吸血することは稀であり，恐らくこれらは鳥類から吸血するものと思われる。