

New records of crane-flies from NW Russia, with ecological notes on some species (Diptera: Tipulidae, Limoniidae)

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Przhiboro, A.A. 2003. New records of crane-flies from NW Russia, with ecological notes on some species (Diptera: Tipulidae, Limoniidae). *Zoosystematica Rossica*, **11**(2), 2002: 361-366.

New regional records are given for 2 species of Tipulidae and 20 species of Limoniidae. Four species are recorded from the European part of Russia for the first time. Information on ecology of praemaginal stages is provided for 12 species. All species listed but one are shown to pass the development within the lake shore zone.

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The paper is based on the materials collected by the author in 1996-2002 at six small lakes in the North-West of Russia: lakes Krivoe and Krugloe (66°21'N 33°35'E; Loukhi Distr. of Karelia), Pionerskoe and Pridorozhnoe (60°18'N 29°17'E; Vyborg Distr. of Leningrad Prov.), Anninskoe and Anisimovo (56°12'N 28°40'E; Sebezh Distr. of Pskov Prov.). Below, in the "Material" section for each species, only the names of lakes are given.

The two northern lakes are oligotrophic, characterized by the littoral vegetation poorly developed and the zone of water margin almost entirely represented by type 1 (for the types of this zone, see Table). The two lakes of the southern group are eutrophic, rich in littoral vegetation; types 2 and 3 of the water margin zone predominate. The two lakes in Leningrad Prov. take an intermediate position (in particular, types 1 and 2 are common within the water margin zone). For details of the study lakes and habitats, see Przhiboro (1999, 2000, 2001a, 2001b).

Methods

At each lake, I studied the littoral zone (depth range: 0.05-1.5 m) and the zone of water margin (= water line zone; within the borders: from 5 cm below the water level to 10 cm above it). Within the latter, three morphological types are recognized (see Table). Qualitative samples and series of quantitative samples ($S = 0.033-0.06 \text{ m}^2$) were taken during the season in 5-11 sites of a lake, in the main habitats of both the littoral and the water margin zones. A folding circle sampler with attached net bag (= grab-net) was mainly used to collect quantitative samples. The

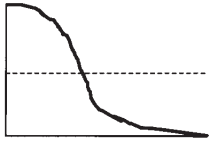
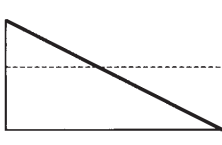
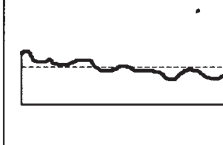
vertical distribution of macrobenthos in bottom substrata was studied with a Mordukhai-Boltovskoj core sampler. All the samples were washed on sieves (the least 0.25 mm mesh), then the benthos was extracted by flotation in strong solution of NaCl, combined with hand-sorting of coarse fraction. A total of 331 quantitative samples (total square = 13 m²) and nearly 200 qualitative samples have been processed.

Imagines of Diptera were reared in laboratory from separate larvae and pupae obtained from samples in the course of processing, as well as from substrata collected in the zone of water margin and kept in laboratory conditions. At Krivoe, Krugloe and Anninskoe lakes, emergence traps were used to collect imagines emerging from water and shore substrata in the littoral zone (depth 0.1-1.0 m, all three lakes) and the water margin zone of type 3 (Anninskoe); a construction similar to those proposed by Sublette & Dendy (1959) and Lammers (1977) (both cited by Davies, 1984) was used; emergence trap was supplied with a sample beaker containing alcohol 50-70% with addition of glycerin and formalin. In addition, imagines were collected with aspirator and by net-sweeping in the above-water and above-ground layers at study sites.

Gut contents of *Tipula* larvae was studied under a Biolam-i microscope at 100-200 \times magnification; percentage of components was estimated by their relative cover in temporary slides.

Larvae were identified according to Brindle (1967), Theowald (1967), Savchenko (1982, 1985, 1986), Reusch & Oosterbroek (1997), Lantsov (1999), and Podjmine (2002). Species identifications of limoniid larvae are tentative. Identifications of all male imagines are based on

Table. Morphological types of the zone of water margin.

Type	1	2	3
Profile (schematically; water level designated by dotted line)			
General characteristic	narrow zone of constant contact with water and air		broad zone near water level
Width (m)	0.1-0.2	< 1	3-50
Wave action	as a rule, present	possible; more often, absent	always absent
Drifted accumulations of plant remains	absent (at most, temporary accumulations of drift in water below the water margin zone)	as a rule, present (as a narrow belt)	absent in most part of zone; if present, more often near the littoral zone or dispersed
Macrophyte vegetation	absent or present (mainly mosses, liverworts and subshrubs)	absent or present (mainly herbaceous)	always abundant; Poaceae and Cyperaceae predominate
Additional characters	most often, the profile is determined by roots of trees and bushes situated close to water		hummocks and hollows are typical, as a consequence of vegetation microzonality

examination of the genitalia. All records but one are based on reared imagines and therefore comprise species developing in corresponding habitats of the lake shore zone.

All the material is deposited at the Zoological Institute, St.Petersburg.

The following abbreviations are used in the text:

1) new records: NK, for Northern Karelia (N of Nadvoitsy, ca. 64°N); PP, for Pskov Prov.; *, far outside the previously known range.

2) larval habitats in lakes of the respective regions: LZ, lake littoral zone; MZ, zone of water margin, with number corresponding to the type of this zone (see Table).

Several widespread species found by me in Northern Karelia have been listed by Rolf Krogerus (1960) for bog habitats situated at about the same latitude (Regio Kuusamoënsis without concrete localities, near the current Russian-Finnish border, 66°00'-66°40'N 29°00'-30°30'E). However that may be, these species were never recorded for the north of Russian Karelia (Savchenko, 1961, 1966, 1982, 1985, 1986, 1989; Savchenko et al., 1992; etc.). Below, they are marked with "•".

Family TIPULIDAE

Tipula benesignata Mannheims, 1954 (NK *: MZ1)

Material. Lake Krivoe, water margin zone: 1 ♂ reared ca. 15.VIII.1998 from larva collected 15.VII.1997; 1 ♂ reared ca. 10.VIII.2000 from substratum collected 6.VII.2000; 1 ♂, 1 ♀ not reared (pharate adults with completely

formed terminalia, inside pupal skins), mid August 1997 from larvae collected 15.VII.1997; more than 150 larvae of instars 3-4, collected VII.1997 and VII.2000.

Notes on biology. Larvae of this species are abundant in the water margin zone of the Krivoe Lake. They develop in the same habitat with *Prionocera turcica* (F.), mainly in microhabitats with dense cover of mosses, and comprise more than half of the total biomass of the macrobenthos and soil mesofauna in the water margin zone (total biomass from 6.5 to 10.6 g/m²). According to field and laboratory observations, *T. benesignata* larvae of instars 3-4 regularly put the anterior body half out the substratum and actively consume the above-ground living parts of mosses (*Pseudobryum cinclinoides* and, possibly, other species). At the same time, nearly 1/3 of shoots of the mosses constituting the turf in this zone were browsed on, with stem bases remaining only (data on the first ten days of June 2000).

However, the gut contents of *T. benesignata* larvae of instars 3-4 collected in this zone include three main components: (1) parts and remains of mosses (*Pseudobryum cinclinoides* (Kindb.) T. Kop., *Rhizomnium punctatum* (Hedw.) T. Kop. and *Calliergon cordifolium* (Hedw.) Kindb.) abundant in the larval habitat and liverworts (*Chiloscyphus polyanthos* (L.) Corda and *Tritomaria quinquedentata* (Huds.) H. Buch were abundant in the larval habitat); (2) cuticle remains of ceratopogonid pupae (*Palpomyia*, *Bezzia*; pupae of these genera are very abundant in the zone of water margin from late June to mid July); (3) pollen-grains of conifers. Usually, these three components together con-

stituted not less than 80% of the gut contents and were in subequal proportions (mosses predominated only in two larvae examined).

In some larvae, unidentified plant fragments or particles of unclear origin constituted up to 20-30%. In three larvae, body appendages of ceratopogonid imagines were found in addition to remains of pupae; these body parts were characteristically curved and not sclerotized, as in pharate imagines inside pupal skins.

Thus, *T. benesignata* is possibly a polysaprophage, with elements of bryophagy and facultative predation.

The pupation and imago emergence occurred in the first half of August (in 1997 and 2000).

The larval biology of this species in the Ukraine was studied by Savchenko (1963, 1966). According to him, *T. benesignata* is an obligate bryobiont at shores of different running waters.

Notes on distribution. New record for the European part of Russia (see: Savchenko, 1961, 1966; Theowald, 1973), predicted by Savchenko (1966) for the north of European Russia. The species has an Alpo-boreal range and is known from the only adjacent region, North and Central Sweden (Theowald, 1955, 1982; de Jong, 1994).

• ***Tipula variicornis variicornis*** (Schummel, 1833) (NK)

Material. Lake Krivoe, water margin zone: 1 ♂, 1 ♀, net sweeping, 8.VII.1997.

Family LIMONIIDAE

Subfamily PEDICIINAE

• ***Dicranota bimaculata*** (Schummel, 1829) (NK: LZ)

Material. Lake Krivoe, water margin zone: 1 ♂ reared 6.VII.2000 from larva collected 25.VI.2000; littoral zone: 14 larvae of instars 2-4 (aff. *bimaculata*), 28.IX.1996, 29.VI.1997, 3.VII.2000 and 12.VI.2002.

Notes on biology. For the lakes studied, *Dicranota* is the only taxon of Tipuloidea with larvae developing at the bottom within the littoral zone (not considering *Erioptera flavata* and *E. squalida* associated closely with the turf of monocotyledones; see below). In the Krivoe Lake, *Dicranota* (*Dicranota*) aff. *bimaculata* larvae of different instars were collected from a depth of 0.5-1 m in several sites, whereas only solitary, mature larvae were found in the zone of water margin.

• ***Tricyphona immaculata*** (Meigen, 1804) (NK: MZ1)

Material. Lake Krivoe, water margin zone: 1 ♂ reared 3.VII.1997 from larva collected 17.VI.1997; 1 ♀ reared

6.VII.1997 from larva collected 17.VI.1997; 1 ♀ reared 28.VI.2000 from substratum collected 25.VI.2000; 9 ♂, 3 ♀, net sweeping, 8.VII.1997; 25 larvae of instars 3-4 (aff. *immaculata*), from June to September 1996-97.

Notes on biology. *Tricyphona* (*Tricyphona*) larvae were common in the water margin zone of the Krivoe Lake.

Subfamily HEXATOMINAE

Helius flavus (Walker, 1856) (PP: MZ)

Material. Lake Anninskoe, water margin zone: 1 ♂, 1 ♀ reared 3 and 6.VI.1998 from larvae collected 12 and 20.V.1998, respectively.

Helius longirostris longirostris (Meigen, 1818) (PP: MZ)

Material. Lakes Anninskoe and Anisimovo, water margin zone: 13 ♂, 19 ♀ reared from larvae and from substrata in 1998-99, from mid May to early September.

Notes on biology. *H. longirostris* (larvae) is the most numerous limoniid species in the water margin zone of Anninskoe and Anisimovo lakes. Larvae of *Helius* are the only Limoniidae inhabiting the surface water layer within the lake littoral zone. In this zone, they occur only in sites with very dense emergent vegetation (*H. aff. longirostris* and *H. aff. pallirostris* are found). At such sites, the upper 5 cm water layer is usually filled with plant remains so that conditions near the water surface seem to be similar to those of the water margin zone of type 3. *Helius* larvae are among several typical inhabitants of the water margin zone (their main habitat in lakes under study) developing also in the littoral near the water surface, along with *Oplodontha viridula* (F.) (Stratiomyidae) and *Hybomitra ciureai* Šiguy (Tabanidae).

Helius pallirostris Edwards, 1921 (PP *: LZ)

Material. Lake Anninskoe, upper littoral zone (in point with depth ca. 0.7 m): 1 ♀ reared 21.II.1998 from larva collected 18.IX.1997.

Notes on distribution. In Russia, the species was recorded only from Astrakhan Prov. (Savchenko, 1989). The nearest records are those from Lithuania (Podimas, 1995) and the Ukraine (Savchenko, 1986).

• ***Idioptera linnei*** Oosterbroek, 1992 (NK *: LZ)

Material. Lake Krivoe, upper littoral zone: 2 ♂, 1 ♀, emergence trap, 1.VII.2000; 1 ♀, emergence trap, 4.VII.2000; 1 ♀, net sweeping, 8.VII.1997; 4 ♀, by aspirator, 1 and 4.VII.2000.

Notes on biology. Larvae of this species were found only in a single point of the littoral zone near the border with the zone of water margin.

They occupy a single habitat peculiar within the Krivoe Lake: mixed stands of *Carex lasiocarpa* Ehrh. and *C. rostrata* Stokes (total cover approx. 20%) at a depth 5-20 cm, with hummocks, silted turf and high quantity of plant remains in the water. Probably, the larva is semiaquatic. Imagines were collected only near the larval habitat. In 2000, emergence of imagines occurred in early July.

Limnophila pictipennis (Meigen, 1818)
(PP *: MZ2)

Material. Lake Anninskoe, water margin zone: 1 ♀ reared 10.X.1998 from substratum collected 25.VII.1998.

Notes on distribution. New record for the European part of Russia (Savchenko, 1989). The nearest records are those from Lithuania (Podenas, 1992), Finland (Savchenko et al., 1992) and the Ukraine (Savchenko, 1983).

Phylidorea abdominalis (Staeger, 1840)
(PP: MZ3)

Material. Lake Anninskoe, water margin zone: 1 ♂, emergence trap, 25.V.1998; Lake Anisimovo, water margin zone: 1 ♂ reared 29.V.1998 from pupa collected 20.V.1998; both lakes, water margin zone: 2 pupae and more than 20 larvae of instars 3-4 (aff. *abdominalis*), IX.1997, V.1998.

Notes on biology. Larvae of this species (along with those of *Ph. ferruginea*) seem to be common in the sites of the water margin zone belonging to type 3, but were not found in the sites of other types, as distinct from *Ph. ferruginea*.

Phylidorea ferruginea (Meigen, 1818)
(NK *: MZ1)

Material. Lake Krivoe, water margin zone: 1 ♂, 1 ♀ reared 30.VI.1997 from larvae collected 17.VI.1997; 2 ♂ reared 28.VI.1998 from substratum collected 25.VI.1998; 2 ♂, net sweeping, 8.VII.1997; 16 larvae of instars 3-4 and 2 pupae (aff. *ferruginea*), June-July 1997.

Notes on biology. Larvae of *Phylidorea* aff. *ferruginea* were common in the water margin zone of the Krivoe Lake.

• **Phylidorea fulvonervosa** (Schummel, 1829)
(NK: MZ1)

Material. Lake Krivoe, water margin zone: 1 ♂ reared 12.VII.2000 from larva collected 25.VI.2000; 1 ♀ reared 11.VII.2000 from substratum collected 6.VII.2000.

Phylidorea longicornis longicornis (Schummel, 1829) (PP: MZ2)

Material. Lake Anninskoe, water margin zone: 1 ♀ reared 12.VIII.1998 from substratum collected 25.VII.1998.

Pilaria decolor (Zetterstedt, 1851) (PP *: MZ2)

Material. Lake Anninskoe, water margin zone: 1 ♂ reared 30.III.1998 from substratum collected 30.IX.1997.

Notes on distribution. New record for Russia (Savchenko, 1989; Savchenko et al., 1992). The nearest records are those from Finland and Sweden (Tjeder, 1955; Savchenko et al., 1992).

Pilaria meridiana (Staeger, 1840)
(PP: MZ2, MZ3)

Material. Lake Anninskoe, water margin zone: 1 ♀ reared 16.VI.1998 from substratum collected 4.VI.1998; 1 ♀ reared 3.X.1998 from substratum collected 25.VII.1998; 1 ♂ reared 17.IX.1999 from substratum collected 11.VII.1999; 1 ♀ reared 23.VIII.1999 from substratum collected 11.VII.1999. Lake Pionerskoe, water margin zone: 1 ♀ reared 30.VII.1998 from substratum collected 15.VII.1998.

Notes on biology. Larvae of this insufficiently studied species are common inhabitants of the water margin zone in lakes (types 2 and 3).

Subfamily LIMONIINAE

Dicranomyia consimilis (Zetterstedt, 1838)
(NK: MZ1)

Material. Lake Krivoe, water margin zone: 1 ♂ reared 23.VII.2000 from substratum collected 6.VII.2000.

Dicranomyia danica Kuntze, 1919 (PP *: MZ3)

Material. Lake Anisimovo, water margin zone: 1 ♂ reared 4.VIII.1999 from substratum collected 12.VII.1999.

Notes on distribution. New record for Russia (Savchenko, 1989; Savchenko et al., 1992). The nearest records are those from Poland, Sweden and Finland (Tjeder, 1958; Savchenko et al., 1992).

Dicranomyia halterella Edwards, 1921
(NK: MZ1)

Material. Lake Krivoe, water margin zone: 1 ♂ reared 10.VIII.2000 from substratum collected 6.VII.2000.

Dicranomyia stigmatica (Meigen, 1830)
(NK *: MZ1)

Material. Lake Krivoe, water margin zone: 4 ♂ reared 10.VII., 13.VII. and 4.VIII.2000 from substrata collected 6.VII.2000; 2 ♀ reared 10 and 13.VII.2000 from substrata collected 6.VII.2000; 1 ♂, 1 ♀ not reared (pharate adults with completely formed terminalia, inside pupal skins), mid August 2000, from larvae collected 6.VII.2000.

Notes on biology. Larvae of *D. stigmatica* were common in the water margin zone of the Krivoe Lake. According to laboratory observations, the last instar larvae feed on fine detritus and do not

consume coarse plant remains. Pupae are very motile, unlike those of other limoniid species observed. In laboratory, pupae showed a tendency to leave substratum and climbed on vertical glass walls of a vial or even on a cover lid of container, and sometimes crawled during 2-3 days moving away from the place of pupation to a distance of 20-30 cm. In 2000, the pupation and imago emergence occurred from early July to mid August.

Dicranomyia ventralis (Schummel, 1829)
(PP: MZ3, ?LZ)

Material. Lake Anninskoe, upper littoral zone: 1 ♂ pupa not reared (pharate adult with completely formed terminalia, inside pupal skin), collected 30.IX.1997; Lake Anisimovo, water margin zone: 1 ♂, 1 ♀ reared 21 and 31.VII.1999, respectively, from substratum collected 12.VII.1999.

Subfamily ERIOPTERINAE

• **Erioptera flavata** (Westhoff, 1882)
(NK: LZ, ?MZ3)

Material. Lake Krivoe, water margin zone: 1 ♂, net sweeping, 8.VII.1997; 4 ♂, 2 ♀, by aspirator, 4.VII.2000; lakes Krivoe and Krugloe, upper littoral zone (depth 5-15 cm): 8 larvae of last instar, June-August 1997. Marsh (with *Carex* spp., *Drosera* spp. and mosses) near shore of lake Krivoe: 1 ♂, emergence trap, 6.VII.2000.

Notes on biology. The larva and pupa are root-piercing, with the life habit probably similar to that of *E. squalida* (see below). However, in all the lakes studied, the larvae were found only in the uppermost littoral zone, although stands of *Carex rostrata* in Krivoe occupy the littoral zone up to a depth 0.7 m. Larvae are found to develop also in a marsh habitat, which is similar to type 3 of the water margin zone.

Erioptera squalida Loew, 1871 (PP: LZ, MZ3)

Material. Lakes Anninskoe and Anisimovo, upper littoral zone (depth 10-100 cm): 5 ♂ and 4 ♀ pupae not reared (pharate adults with completely formed terminalia, inside pupal skins), collected in July 1998 and 1999; several hundred larvae of all instars, collected from May till October, 1997-1999; more than 200 imagines (♂♂ and ♀♀, including those in copula), by aspirator, 11 and 25.VII.1998, 11.VII.1999.

Notes on biology. Larvae of *Erioptera squalida* are found to develop in a single habitat of the littoral zone: dense stands with predominating emergent macrophytes (*Carex rostrata* Stokes, *Scirpus lacustris* L., *Acorus calamus* L., *Phragmites australis* (Cav.) Trin. ex Steud., *Glyceria maxima* (Hartm.) Holmb., *Typha latifolia* L.), at a depth of 0.1 to 0.7 m, in places, to 1 m. In this zone at many sites protected from the wave ac-

tion, the roots of monocotyledones constitute dense silted turf up to 10 cm thick, which accumulates high quantity of plant remains. Larvae occur exclusively in the layer of turf and are rather abundant (mean densities during the season lied within the range 150-335 ind./m², mean biomasses, within 0.25-0.95 g/m²; the latter comprised up to 3% of the total biomass of macrobenthos). Specifically, they are completely absent in qualitative samples taken with net and abundant in quantitative benthic samples. According to my data, *E. squalida* belongs to a sinusia of turf inhabitants, which includes several root-piercing larval forms of Diptera [*Chrysops rufipes* Meigen (Tabanidae), *Melanogaster aerea* (Loew) (Syrphidae) and *Notiphila* spp. (Ephydriidae)] and also larvae of *Palpomyia tibialis* (Meigen) (Ceratopogonidae). Larvae of *E. squalida* were not found in the association of *Sagittaria sagittifolia* L. and *Potamogeton natans* L. (as distinct from *Ch. rufipes*, *P. tibialis* and *Notiphila*), as well as in the pure stands of *Nuphar lutea* (L.) Smith, *Sparganium* spp., *Phragmites australis*, *Scolochloa festucacea* (Willd.) Link, *Acorus calamus*. Unlike other members of the sinusia, *E. squalida* larvae penetrate up to a depth of 10 cm into the thickness of turf.

Thus, *E. squalida* provides a unique example of metapneustic limoniid larvae inhabiting the bottom up to 1 m beneath the water surface and pupating there. The species is common also in the zone of water margin (type 3 only), but the density and biomass of larvae are generally lower. According to laboratory observations, larvae are detritivorous, and the root-piercing is not permanently used for respiration (respiration may occur for many days through the body surface in the water or in saturated mud as well as through the spiracles direct from the air). The pupation and mass emergence of imagines occurred during July (in 1998 and 1999). For details see Przhiboro (2000, 2001b).

Acknowledgements

I am grateful to Drs. T.V. Egorova, L.E. Kurbatova and A.D. Potemkin (Komarov Botanical Institute, St.Petersburg) for identification of monocotyledones, mosses and liverworts, respectively, and to Dr. V.I. Lantsov (Institute for Ecology of Mountainous Territories, Nalchik) for the help in identification of preimaginal *Erioptera* and for numerous consultations. The work was supported by grants of the President of the Russian Federation for young scientists – candidates of science (no. MK-2192.2003.04) and for leading scientific schools (no. IIII-1634.2003.4).

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Received 1 April 2003