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# Novel Data on the Taxonomic Diversity, Distribution, and Host Plants of Leafmining Moths of the Family Gracillariidae (Lepidoptera) in Siberia, Based on DNA Barcoding

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**Abstract**—The Gracillariidae fauna of Siberia, the region that occupies almost half of the territory of the Russian Federation, remains poorly studied. During a DNA barcoding study of Gracillariidae in Siberia, based on analysis of larvae and pupae collected from their leaf mines on woody plants, we identified 41 species. Three gracillariids were identified only to genus: *Caloptilia* sp. (host plant *Prunus padus*), *Parornix* sp. (*Malus* sp.), and *Phyllonorycter* sp. (*Crataegus* sp.), representing poorly studied or undescribed species. Six species are reported here for the first time for Siberia: *Callisto insperatella* (from Novosibirsk and Tomsk provinces), *Caloptilia alnivorella* (Buryatia), *Phyllonorycter ermani* (Irkutsk Province), *Ph. lantanella* (Novosibirsk Province), *Ph. pumilae* (Omsk and Irkutsk provinces), and *Ph. viciae* (Krasnoyarsk Territory). *Parornix pfaffenzelleri*, found in Khakassia, is reported as a species new to Russia. Other 15 gracillariid species previously known from Siberia were recorded in new administrative regions. The invasive lime leafminer *Phyllonorycter issikii* was first documented in Tomsk Province and Krasnoyarsk Territory in 2017 and 2018, respectively. Seven new gracillariid–host plant associations were found: *Parectopa ononidis* on *Lupinaster pentaphyllus*, *Sauterina hofmanniella* on *Lathyrus gmelinii*, *Caloptilia stigmatella* on *Salix kochiana*, *Callisto insperatella* on *Prunus virginiana*, *Parornix scoticella* on *Amelanchier* sp., *Phyllonorycter ermani* on *Alnus alnobetula* subsp. *fruticosa*, and *Phyllonorycter viciae* on *Vicia unijuga*. The Gracillariidae fauna of Siberia has 51% similarity with that of European Russia and only 38% similarity with that of the Russian Far East.

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The micromoth family Gracillariidae has a cosmopolitan distribution and comprises more than 2000 species (De Prins, De Prins, 2018). The family is one of the most species-rich in the Palaearctic, where these moths develop on a wide range of woody and herbaceous plants (Lopez-Vaamonde et al., 2003, 2006). Gracillariid moths are an endophagous group of insects: the larvae of the majority of species mine leaves and a few species mine young shoots and fruits, i.e., they live and feed inside the plant tissues without damaging the epidermis during the whole larval stage or a part of it (Hering, 1951; Davis, 1987). Some species, in particular those of the genera *Phyllonorycter* and *Caloptilia*, make galls (Busck, 1904; Kumata, 1966; De Prins and Kawahara, 2012). The family is known for having many garden, park, and forest pests. Some species, especially the members of the genera *Cameraria*, *Phyllocnistis*, and *Phyllonorycter*, are invasive pests causing extensive damage to plants in natural and urban ecosystems (Kirichenko et al., 2018a).

Although the family is sufficiently well studied in the Palaearctic (De Prins and De Prins, 2018), the fauna of some of its regions is still poorly known. One of such regions is Siberia, which occupies nearly half the territory of Russia. Until recently, a total of 55 species of Gracillariidae have been known from Siberia (Tomilova, 1962, 1973, 1977; Dovnar-Zapolsky and Tomilova, 1978; Barannik, 1981; Tarasova et al., 2004; Baryshnikova, 2008, 2014; Dubatolov, 2013; Chursina et al., 2016). Remarkably, 24 species, i.e., 45% of all gracillariids in Siberia, were recorded for Irkutsk Province (Baryshnikova, 2008), thanks to thorough research carried out in the region by V.N. Tomilova and D.P. Dovnar-Zapolsky in the 1950–1970s. The number of gracillariid species currently known in Siberia is nearly three times less than that recorded in European Russia (133 species) (Baryshnikova, 2008, 2014; Kozlov et al., 2017) or in the Russian Far East (135 species) (Baryshnikova, 2016; Kirichenko et al., 2019a).

Faunistic research in vast territories would hardly be possible without the use of modern techniques, in particular the method of molecular diagnostics known as DNA barcoding (Hausmann et al., 2011; Huemer et al., 2014a). This method is efficiently applied to taxonomic identification (Ratnasingham and Hebert, 2013; Lees et al., 2014; Huemer et al., 2014a; Huemer and Hebert, 2016), phylogenetics (Kawahara et al., 2017), and phylogeography (Valade et al., 2009; Kirichenko et al., 2017b; Tóth and Lakatos, 2018). A great advantage of DNA barcoding is that it can be used to identify species based on any developmental stage. DNA can be extracted from tiny amounts of biological material which can be sampled without damaging the insect, so that rare specimens can be preserved for subsequent morphological examination (Phillips and Simon, 1995; Castalanelli et al., 2010). The possibility of recovering the DNA of leaf-mining insects from freshly vacated leaf mines opens new prospects for molecular diagnostics of various taxa of leaf-miners (Mlynarek et al., 2016). At the same time, it should be kept in mind that species identification through DNA barcoding is possible only when reference sequences (i.e., barcodes associated with reliably identified material, confirmed by morphological diagnostics) are available in the genetic databases. The use of classical morphological method is essential when identifying species that have not been barcoded previously, resolving disputable taxonomic situations, and describing new taxa. The combination of two methods certainly improves the results of taxonomic and faunistic studies.

This paper summarizes the results of integrative research of gracillariid diversity, distribution, and trophic relations in Siberia, performed with the use of DNA barcoding. Identification of some species was additionally supported by examination of adult morphology. Here we report new regional records and indicate potentially new species of Gracillariidae and novel trophic relations of certain gracillariid species in Siberia. It is demonstrated that the species composition of Gracillariidae in Siberia is more similar to that of European Russia than to that of the Russian Far East.

## MATERIALS AND METHODS

### *The Material and Study Region*

The specimens were collected in June–August 2008–2018 in 14 administrative regions of Siberia: Tyumen Province, Khanty-Mansi Autonomous Okrug, Omsk, Tomsk, Novosibirsk, and Kemerovo provinces, Krasnoyarsk and Altai territories, Khakassia, Altai, and Tuva republics, Irkutsk Province, Republic of Buryatia, and Transbaikal Territory. We mostly visited the southern localities along the Trans-Siberian Railway, covering 4200 km (Fig. 1). This allowed us to collect leaves with mines from many distant localities within a relatively short period of time. The northern regions of Khanty-

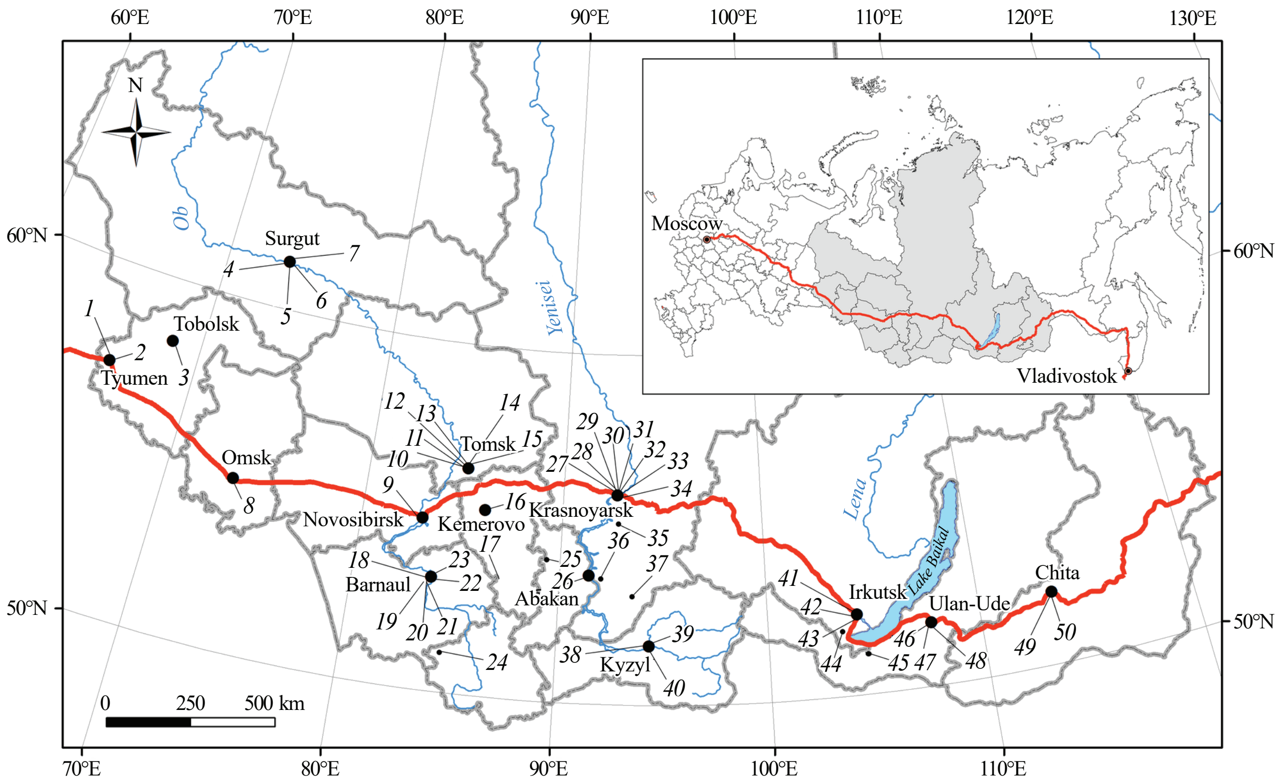


**Fig. 1.** The collection localities: *1–3*, Tyumen Province: *1*, *2*, Tyumen: *1*, Zatyumensky Park; *2*, Semena Patsko public garden; *3*, Tobolsk (Ermak Park). *4–7*, Khanty-Mansi Autonomous Okrug, Surgut: *4*, Khranitelei Surguta Park; *5*, Energetikov Park; *6*, Surgut State University (SurSU); *7*, Kedrovyi Log Park. *8*, Omsk Province, Omsk, Park Pobedy. *9*, Novosibirsk Province, Novosibirsk, Central Siberian Botanical Garden (CSBG), Siberian Branch of the Russian Academy of Sciences. *10–15*, Tomsk Province: *10–14*, Tomsk: *10*, Siberian Botanical Garden (SBG); *11*, experimental plot of Siberian Botanical Garden; *12*, Lagerny garden; *13*, Tomsk State University; *14*, boulevard along Herzen Street; *15*, Tomsk District, Kurlek, Kedr research station. *16*, *17*, Kemerovo Province: *16*, Kemerovo, Antoshka Park; *17*, Kuzedeevo, lime grove. *18–23*, Altai Territory, Barnaul: *18*, Izumrudny Park; *19*, Tselinnikov Park; *20*, Krasnoarmeisky Avenue; *21*, arboretum of Siberian Research Institute for Horticulture; *22*, Zmeinogorsky road, pine forest; *23*, suburb area. *24*, Altai Republic, Kamlak, Altai Mountain Botanical Garden. *25*, *26*, Khakassia: *25*, Chernoe Ozero, research station of Sukachev Institute of Forest, Siberian Branch of the Russian Academy of Sciences; *26*, Abakan, Central recreation park. *27–37*, Krasnoyarsk Territory: *27–34*, Krasnoyarsk: *27*, arboretum of Sukachev Institute of Forest, Siberian Branch of the Russian Academy of Sciences; *28*, Akademgorodok; *29*, Svobodny Avenue; *30*, Udachny district; *31*, Central recreation park; *32*, environs of Karaulnaya research station; *33*, Borovoe gardener community; *34*, Trostentsovo station; *35*, Sosnovoborsk; *36*, Minusinsk; *37*, Tanzybei. *38–40*, Tuva Republic, Kyzyl: *38*, National park; *39*, yard plantings; *40*, Botanical Garden of Tuva State University. *41–44*, Irkutsk Province: *41*, *42*, Irkutsk: *41*, Botanical Garden of Irkutsk State University; *42*, Karl Marx Street; *43*, Listvyanka, Baikal astrophysical observatory; *44*, Shelekhov, Komsomolsky boulevard. *45–48*, Buryatia: *45*, Hamar-Daban Mountain Range; *46–48*, Ulan-Ude: *46*, Memorial Pobedy Park; *47*, Smolin Street; *48*, bus station. *49*, *50*, Transbaikal Territory, Chita: *49*, Park Pobedy; *50*, Zheleznodorozhny District. The study region is shown in gray on the inset; the Trans-Siberian Railway is shown as the red line.

Mansi Autonomous Okrug and Tomsk Province were visited only during the last year of the study.

To sample all the possible gracillariids, the specimens were collected not only in natural ecosystems but also in botanical gardens, arboreta, parks, street and yard plantings in the administrative centers of the regions, gathering a wide range of local and introduced woody plant species. In Novosibirsk and Irkutsk provinces and in Krasnoyarsk and Altai territories, we also examined the natural forest stands around the cities. The most regular collections (2–5 times a season, for 11 years) were carried out in Novosibirsk Province and Krasnoyarsk Territory, while the other regions were visited once or twice during the whole study period.

### *Methods of Material Collection*

Larvae and, less frequently, pupae of Gracillariidae were collected directly from their mines on the leaves of woody plants from the families Adoxaceae, Betulaceae, Caprifoliaceae, Cornaceae, Fabaceae, Malvaceae, Oleaceae, Rosaceae, Salicaceae, and Ulmaceae, which are widespread in Siberia and commonly used for urban landscaping (Koropachinsky and Vstovskaya, 2012). Some species were also collected from leaf mines on herbaceous plants from the family Fabaceae. When looking for leaf mines, we examined the upper and lower sides of 100–500 leaves per tree, taken from the lower branches from four opposite directions; the shrubs and herbaceous plants were examined completely. Adults of two species, *Phyllonorycter pastorella* and *Ph. populifoliella*, were also collected from poplar trunks, and those of *Parornix pfaffenzelleri* were captured in a light trap.

The larvae and pupae found in leaf mines were placed in 1.5-ml vials (Axygen, USA) with 96% ethanol and stored at −10° to preserve their DNA. The leaves with characteristic mines were preserved in a herbarium. Larvae and pupae of some species were reared to obtain adults (Hering, 1951; Ohshima, 2005). The moths were pinned and stored as regular dry collection specimens. In case of mass emergence of moths, some specimens were also preserved in 96% ethanol.

### *Species Identification*

The samples of Gracillariidae (113 specimens, including 100 larvae, 6 pupae, and 7 adults) were DNA barcoded by sequencing the 658-bp barcoding fragment of the mitochondrial COI gene (Folmer et al., 1994). DNA was extracted from the samples using the XS kit (Macherey-Nagel, Germany), following the manufacturer protocol, and amplified with the standard primers LCO (5' GGT CAA CAA ATC ATA AAG ATA TTG G 3') and HCO (5' TAA ACT TCA GGG TGA CCA AAA AAT CA 3') (Folmer et al., 1994). The amplicons were purified using the PCR Clean-up kit (Macherey-Nagel, Germany), sequenced by the Sanger method using the Abi Prism® BigDye® Terminator 3.1 kit, and analyzed using the Applied Biosystems® 3500 genetic analyzer (USA). The conditions of amplification and sequencing were described in our earlier papers (Kirichenko et al., 2016, 2017b). DNA barcoding was performed in the Forest zoology laboratory of the French National Institute for Agricultural Research (INRA, Orléans). Sequences were edited in CodonCode Aligner V.3.7.1 and aligned in BioEdit 7.0.5.3 (Hall, 1999). The obtained DNA barcodes of Gracillariidae from Siberia and the field data (collection sites and dates, host plants, and photos of the voucher specimens) were deposited in the BOLD database and can be accessed at dx.doi.org/10.5883/DS-GRASIB.

The samples were identified by their DNA barcodes in the BOLD database (Ratnasingham and Hebert, 2007), the largest and progressively developing database which currently holds about 22 thousand DNA barcodes of Gracillariidae (http://www.boldsystems.org). The obtained sequences were matched with the reference barcodes by calculating genetic divergence, using the algorithm implemented in BOLD (Ratnasingham and Hebert, 2007). The minimal distance usually did not exceed the 2% threshold that is commonly used for identification of Microlepidoptera species (Hebert et al., 2010; Rougerie et al., 2014). When identifying specimens, we also considered the correspondence between the DNA barcodes of the analyzed specimens and the unique barcode index numbers (BINs) that are assigned to each sequenced sample within the BOLD database (Ratnasingham and Hebert, 2013).

For the samples which could not be identified to species by their DNA barcodes due to the absence of reference sequences in the BOLD database, we determined the nearest neighbors, i.e., species showing the highest genetic similarity to our specimens. The phylogenetic tree reflecting the relationships between the Siberian specimens was built with the maximum likelihood algorithm in MEGA 7.0.26 (Kumar et al., 2016), using the Kimura 2-parameter model and the bootstrap method with 2500 iterations. The members of the family Gracillariidae that have not been identified to species are listed in the text as sp.; they differ from the closely related species by their DNA barcodes, BINs, host plants, and characteristic leaf mine patterns.

Identification of some species was clarified based on morphological features of the leaf mines, pupae (Hering, 1957; Gregor and Patočka, 2001; Ellis, 2018), and adults (*Key to the Insects of the European Part of the USSR*, 1978; *Key to the Insects of the Russian Far East…*, 1997; *Insects and Acarines…*, 1999). The genitalia were mounted on slides in Euparal, following the standard technique (Robinson, 1976).

### *The Faunistic List*

The list of species was compiled based on collections of N.I. Kirichenko and two findings made by E.N. Akulov; the latter collector is indicated in the text. The list comprises the new faunistic records and also the species previously known from Siberia according to the literature data, including our recent publications (Tomilova, 1962, 1973; Dovnar-Zapolsky and Tomilova, 1978; Barannik, 1981; Yanovsky, 1996, 2003; Tarasova et al., 2004; Baryshnikova, 2008, 2014; Dubatolov, 2013; Kirichenko, 2013; Kirichenko and Pustoshinskaya, 2016; Anikin et al., 2016; Kirichenko et al., 2016, 2017a, 2017b, 2017c, 2017d, 2018b, 2018c, 2019b; Akulov et al., 2018; Knyazev et al., 2018, 2019), whose presence in Siberia was confirmed by new collections in this region. We followed the taxonomy of the family Gracillariidae proposed by Kawahara and co-authors (2017). Data on the trophic specialization and the host plants of the larvae were emended using the available online catalogues (De Prins and De Prins, 2018; Ellis, 2018).

The species of Gracillariidae were divided into three groups by the degree of their trophic specialization: monophagous species, developing on plants of one genus; oligophagous species, developing on plants of one family; polyphagous species, developing on plants from different families and orders (Hering, 1951).

The data provided for each species in the faunistic list below include the collection locality, host plant, collection date and sampling method, the number of specimens examined, the specimen field number, the BOLD specimen ID (beginning with SIBLE, MICRU, ISSIK or GRPAL), and the barcode index number (BIN) (always beginning with BOLD). If several specimens of the same species were barcoded, the BIN is given in square brackets after the list of specimens. In the case when several BINs were found in the BOLD database for the same species, the respective BIN is given for each specimen or group of specimens (in the latter case, also in square brackets).

The degree of trophic specialization and the host plants are indicated for each gracillariid species, based on the literature data and our observations. The host plants recorded for the first time are mentioned in the gracillariid species entries.

The following designations are used: * species recorded for the first time for a certain region of Siberia; ** species recorded for the first time for Siberia as a whole; *** species recorded for the first time for the territory of Russia. The institutions are abbreviated as follows: CSBG, Central Siberian Botanical Garden, Siberian Branch of Russian Academy of Sciences, Novosibirsk; ISU, Irkutsk State University; SB RAS, Siberian Branch of Russian Academy of Sciences; SBG, Siberian Botanical Garden of Tomsk State University, Tomsk; SurSU, Surgut State University; TuvSU, Tuva State University, Kyzyl.

The insect specimens and leaves with characteristic mines are kept at Sukachev Institute of Forest, Siberian Branch of Russian Academy of Sciences (Krasnoyarsk, Russia), some specimens, at Museo Civico di Storia Naturale (Verona, Italy), the voucher specimens and DNA extracts of Gracillariidae, at the Forest zoology laboratory of the French National Institute for Agricultural Research (INRA; Orléans, France).

### *Comparative Analysis of the Species Composition of Gracillariidae in Siberia, European Russia, and the Russian Far East*

The Gracillariidae checklists for Siberia, European Russia, and the Russian Far East were compiled based on the literature data (Barannik, 1981; Yanovsky, 1996, 2003; Tarasova et al., 2004; Baryshnikova, 2008, 2014, 2016; Dubatolov, 2013; Baryshnikova and Dubatolov, 2016; Chursina et al., 2016), including our recent publications (Kirichenko, 2013; Kirichenko and Pustoshinskaya, 2016; Anikin et al., 2016; Kirichenko et al., 2016, 2017a, 2017b, 2017c, 2017d, 2018b, 2018c, 2019a, 2019b; Akulov et al., 2018; Knyazev et al., 2018), and the new data reported herein. The checklists were compared using the Sørensen index: $K = 2C/(A + B)$, where $C$ is the number of species common to the lists compared, and $A$ and $B$ are the numbers of species in each list (Magurran, 2004).

## RESULTS

### *Species Identification*

DNA barcoding of the samples collected in Siberia allowed us to identify 41 species from 9 genera and 6 subfamilies of Gracillariidae: Lithocolletinae (*Phyllonorycter*: 22 species), Parornichinae (*Callisto*: 2 species, *Parornix*: 4), Gracillariinae (*Caloptilia*: 4, *Gracillaria*: 1), Acrocercopinae (*Sauterina*: 1), Ornixolinae (*Micrurapteryx*: 2, *Parectopa*: 1), and Phyllocnistinae (*Phyllocnistis*: 4 species). The range (min–max) of genetic interspecific divergence within one subfamily, inferred from the data of analysis of COI mtDNA gene sequences

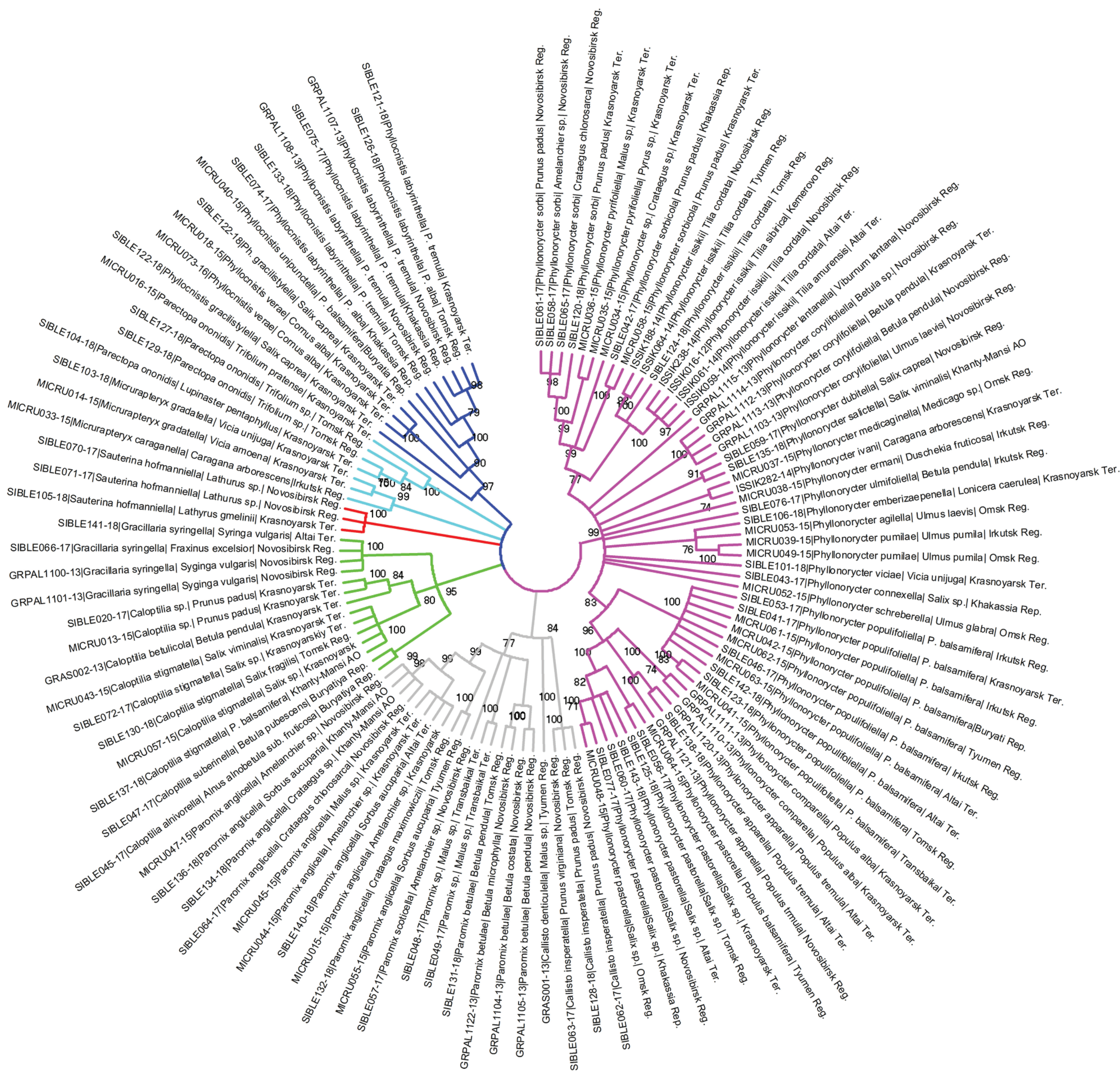

**Fig. 2.** Phylogenetic tree reflecting the relationships of 113 specimens of Gracillariidae from Siberia, based on the analysis of COI mtDNA gene fragments. The tree was built with the nearest-neighbor algorithm (the K2P nucleotide substitution model). Data for each specimen are given in the following format: the BOLD specimen ID (beginning with SIBLE, MICRU, ISSIK or GRPAL) | species name | host plant | region of collection. The branch length is proportional to the relationship level. The subfamilies are color coded: Lithocolletinae (purple), Parornichinae (gray), Gracillariinae (green), Acrocercopinae (red), Ornixolinae (sky blue), and Phyllocnistinae (dark blue). Only the bootstrap test values ≥ 70 are shown. The ranges of genetic variation of the taxa are given in the text.

using the nearest-neighbor algorithm, was 3–16.7% for Lithocolletinae, 7.4–12.3% for Parornichinae, 5.8–14.8% for Gracillariinae, 9.2–16.2% for Ornixolinae, and 8.7–15.9% for Phyllocnistinae (Fig. 2); calculations were not performed for the subfamily Acrocercopinae because it was represented by a single species in the collection. The species were identified by their DNA barcodes with high reliability, most frequently with 2% threshold (the minimal interspecific difference), and their sequences usually well corresponded to the species-specific BINs in the BOLD database. Species diagnostics using DNA barcodes also revealed some problematic cases, when the same species was represented by several BINs in the database, while some Siberian sequences could be assigned to different BINs within the same species. Such problematic species complexes were *Caloptilia alnivorella*, *Parornix anglicella*, *P. betulae*, *Phyllonorycter sorbicola*, and *Phyllocnistis unipunctella* (see the faunistic list for details).

The DNA barcodes and BINs of *Phyllonorycter ermani* and *Ph. viciae* obtained in our research became new reference data in the BOLD database. The species identity of the corresponding samples was confirmed by studying the male genital morphology.

Three members of the family Gracillariidae could be reliably identified only to genus: *Caloptilia* sp. (host plant *Prunus padus*), *Parornix* sp. (*Malus* sp.), and *Phyllonorycter* sp. (*Crataegus* sp.).

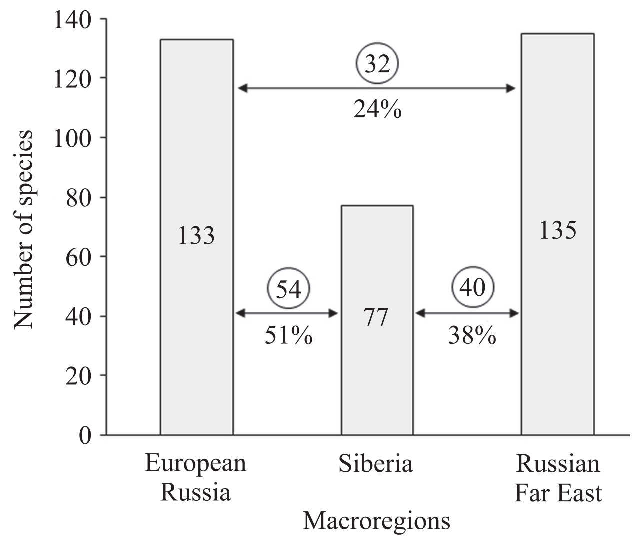


**Fig. 3.** Similarity of the Gracillariidae faunas of Siberia, European Russia, and the Russian Far East. The number of species (according to the literature data and the new findings reported herein) is given on the bars. The number of species shared by the compared macroregions is shown in circles above the arrows; the Sørensen similarity index (%) is shown below the arrows.

### *Trophic Associations*

Of the 41 identified species of Gracillariidae, 25 are monophagous, 15 are oligophagous, and 1 species (*Phyllonorycter corylifoliella*) is polyphagous. These species and three more members of the family whose identity remains unclear develop in Siberia on host plants from 9 families: Salicaceae (11 species of Gracillariidae), Rosaceae (11), Betulaceae (8), Fabaceae (6), Ulmaceae (4), Oleaceae, Caprifoliaceae, Malvaceae, and Adoxaceae (1 species of Gracillariidae on each plant family). The trophic relations of seven species of Gracillariidae, confirmed by the findings of larvae in the leaf mines, are recorded here for the first time: *Parectopa ononidis* was found in Siberia on *Lupinaster pentaphyllus*, *Sauterina hofmanniella* on *Lathyrus gmelinii*, *Caloptilia stigmatella* on *Salix kochiana*, *Callisto insperatella* on *Prunus virginiana*, *Parornix scoticella* on *Amelanchier* sp., *Phyllonorycter ermani* on *Alnus alnobetula* subsp. *fruticosa*, and *Phyllonorycter viciae* on *Vida unijuga*.

### *New Regional Records*

*Parornix pfaffenzelleri*, found in Khakassia, is recorded for the first time in Russia. Six species in our collections are recorded for the first time for Siberia: *Callisto insperatella* based on the records from Novosibirsk and Tomsk provinces, *Caloptilia alnivorella* from Buryatia, *Phyllonorycter ermani* from Irkutsk Province, *Ph. lantanella* from Novosibirsk Province, *Ph. pumilae* from Omsk and Irkutsk provinces, and *Ph. viciae* from Krasnoyarsk Territory (see table). The presence in new regions, mostly in Tomsk and Novosibirsk provinces and Krasnoyarsk Territory, was recorded for 15 species of Gracillariidae that had been previously known from some other regions of Siberia. The lime leafminer *Phyllonorycter issikii*, an invasive species of East Asian origin, was recorded for the first time in Tomsk Province and Krasnoyarsk Territory.

### *Comparative Analysis of the Species Richness of Gracillariidae in Siberia, European Russia, and the Russian Far East*

Considering the literature data and our new findings, the known fauna of Gracillariidae in Siberia comprises 77 species (Fig. 3). The species composition of the family in Siberia is more similar to that of European Russia (the Sørensen similarity index is 0.51) than to that of the Russian Far East (0.38). Of the 77 species revealed in Siberia and 133 species distributed in the west of Russia, 54 species are common to the two macroregions. The fauna of the Russian Far East comprises 135 species and shares 40 species with that of Siberia. The Gracillariidae faunas of European Russia and the Russian Far East are less similar: these macroregions have only 32 species in common, and the corresponding Sørensen similarity index is only 0.24 (Fig. 3).

*List of Species of the Family Gracillariidae Collected in Siberia in 2008–2018*

Subfamily ORNIXOLINAE
Kuznetzov et Baryshnikova, 2001

***Parectopa ononidis** (Zeller, 1839)

Kirichenko et al., 2016 : 106 (Krasnoyarsk Territory); Knyazev et al., 2018 : 263 (Omsk Province).

**Material.** **Tomsk Province*. Tomsk, Kurlek, Kedr research station, *Trifolium* sp., 27.VI.2017, 2 larvae, NK638, SIBLE127-18, NK640, SIBLE129-18; Tomsk, SBG, test plot, *T. pratense*, 29.VI.2017, 1 larva. *Krasnoyarsk Territory*. Krasnoyarsk, suburb, left bank of Yenisei River, env. of Borovoe gardener community, Berkut rock, *Trifolium pratense*, 05.VII.2015, 1 larva, NK461, MICRU016-15; Sosnovoborsk, pine forest, *Lupinaster pentaphyllus*, 10.VIII.2017, 1 larva, NK615, SIBLE104-18 [BOLD:AAE3311].

Oligophage on Fabaceae: *Trifolium*, *Ononis* (De Prins and De Prins, 2018); *Lupinaster pentaphyllus* is recorded here for the first time as its host plant.

***Micrurapteryx caraganella** (Hering, 1957)

Kirichenko et al., 2016 : 113–124 (Tyumen, Omsk, Novosibirsk provinces, Altai and Krasnoyarsk territories, Irkutsk Province, Transbaikal Territory), with diagnostic characters of the species differentiating it from *M. gradatella*; Kirichenko and Pustoshinskaya, 2016 : 30 (Buryatia); Kirichenko et al., 2017c : 143 (Tuva); Akulov et al., 2018 : 122 (Krasnoyarsk Territory).

**Material.** **Kemerovo Province*. Kemerovo, Antoshka Park, *Caragana arborescens*, 26.VII.2015, 1 pupa. *Krasnoyarsk Territory*. Krasnoyarsk, Akademgorodok, *C. arborescens*, 25.VIII.2018, 1 ♂ (adult reared from leaf mine), NK-18-1; Tanzybei, West Sayan foothills, dwarf pine forest, *C. arborescens*, 18.VI.2017, 1 larva. *Tuva*. Kyzyl, yard plantings, *C. arborescens*, 13.VII.2016, 2 larvae, 1 pupa. *Irkutsk Province*. Irkutsk, Botanical Garden of ISU, *C. arborescens*, 7.VIII.2015, 1 pupa, NK478, MICRU033-15, BOLD:ACC5842.

Monophage on *Caragana* (Fabaceae) (Kirichenko et al., 2016).

***Micrurapteryx gradatella***
(Herrich-Schäffer, 1855)

Kirichenko et al., 2016 : 102 (Krasnoyarsk Territory).

**Material.** *Krasnoyarsk Territory*. Krasnoyarsk, left bank of Yenisei River, env. of Karaulnaya research station, *Vicia amoena*, 03.VII.2015, 1 larva, NK459, MICRU014-15; Sosnovoborsk, pine forest, *V. unijuga*, 9.VIII.2017, 1 larva, NK614, SIBLE103-18 [BOLD: AAG3706].

Oligophage on Fabaceae: *Lathyrus*, *Vicia* (Kirichenko et al., 2016).

Subfamily GRACILLARIINAE Stainton, 1854

****Caloptilia alnivorella** (Chambers, 1875)

**Material.** *Buryatia*. Hamar-Daban Range, road to Buchilai, *Alnus alnobetula* subsp. *fruticosa*, 19.VI.2016, 1 pupa, NK556, SIBLE045-17, BOLD:ADF4361.

Probably monophage on *Alnus* (Betulaceae) (Ellis, 2018); however, *Betula*, *Acer*, and *Quercus* were also reported as host plants in Canada, so that the species may be polyphagous (Robinson et al., 2002).

**Remarks.** The nearest neighbor of the Siberian specimen in the BOLD database is *C. alnivorella* from Canada (CNFDB021-14; BOLD:ACF3683) with genetic distance 1.9%. There is confusion in the BOLD database concerning the diagnostics of *C. alnivorella* and the closely related *C. alnicolella* Chambers. The two species are difficult to differentiate morphologically, and their taxonomy remains obscure. The synonymy of *C. alnivorella* and *C. alnicolella* was proposed a century ago (Ely, 1918) but it was not formally established, and further studies are needed to reconfirm it.

***Caloptilia betulicola** (Hering, 1928)

Kirichenko et al., 2017d : 97; Akulov et al., 2018 : 122 (Krasnoyarsk Territory); Knyazev et al., 2018 : 263 (Omsk Province).

**Material.** **Kemerovo Province*. Kuzedeevo, lime grove, *Betula pendula*, 24.VI.2013, 2 larvae. *Krasnoyarsk Territory*. Krasnoyarsk, Udachny district, Yenisei River bank, *B. pendula*, 19.VI.2013, 2 larvae, 1 ♂ (adult reared from leaf mine); same locality, *B. pendula*, 25.V.2015, 1 larva, NK92, GRAS002-13, BOLD:

AAE3420; Tanzybei, West Sayan foothills, dwarf pine forest, *B. pendula*, 18.VI.2017, 1 larva.

Monophage on *Betula* (De Prins and De Prins, 2018; Ellis, 2018).

### ****Caloptilia stigmatella*** (Fabricius, 1781)

Kirichenko and Pustoshinskaya, 2016 : 30 (Buryatia); Akulov et al., 2018 : 122 (Krasnoyarsk Territory, Khakassia); Knyazev et al., 2018 : 264 (Omsk Province).

**Material.** **Khanty-Mansi Autonomous Okrug*. Surgut, SurSU, roadside plantings, *Populus balsamifera*, 1.VII.2017, 1 larva, NK648, SIBLE137-18; same locality, Energetikov Park, *P. balsamifera*, 02.VII.2017, 1 larva. **Tomsk Province*. Tomsk, Kurlek, Kedr research station, *Salix fragilis*, 27.VI.2017, 1 larva, NK641, SIBLE130-18; Tomsk, Lagerny garden, *Salix* sp., 28.VI.2017, 1 larva. **Novosibirsk Province*. Novosibirsk, CSBG, *S. kochiana*, 5.VIII.2011, 1 larva; same locality, *Salix fragilis*, 25.VI.2012, 1 larva, 1 pupa. *Krasnoyarsk Territory*. Krasnoyarsk, suburb, left bank of Yenisei River, env. of Karaulnaya research station, *Salix* sp., 18.VI.2015, 1 larva, NK502, MICRU057-15; same locality, *Salix viminalis*, 26.VI.2015, 1 larva, NK488, MICRU043-15; env. of Borovoe gardener community, *Salix* sp., 07.VII.2016, 1 larva, NK583, SIBLE072-17 [BOLD:AAA9984]. *Transbaikal Territory*. Chita, Park Pobedy, *Salix* sp., 20.VI.2016, 2 larvae.

Mostly oligophage on Salicaceae: *Salix*, *Populus*; rarely occurs on *Myrica* (Myricaceae) and *Betula* (Betulaceae) (Ellis, 2018). *Salix kochiana* is recorded here for the first time as the host plant. The mines of the species were recorded in great numbers on narrow-leaved willows in the suburbs of Krasnoyarsk in 2015.

### ****Caloptilia suberinella*** (Tengström, 1848)

**Material.** *Buryatia*. Hamar-Daban Range, road to Buchilai, *Betula pubescens*, 19.VI.2016, 1 larva, NK558, SIBLE047-17, BOLD:AAF8460.

Monophage on *Betula* (Ellis, 2018).

### ***Caloptilia*** sp.

**Material.** *Krasnoyarsk Territory*. Krasnoyarsk, suburb, left bank of Yenisei River, env. of Karaulnaya research station, *Prunus padus*, 26.VI.2015, 1 larva, NK458, MICRU013-15; environs of Borovoe gardener community, *P. padus*, 07.VII.2016, 1 ♂ (adult reared from leaf mine), NK531, SIBLE020-17 [BOLD: ACX7847].

**Remarks.** A member of the genus *Caloptilia* was recorded on *Prunus padus* for the first time in the territory of Russia. Four species of this genus are known to develop on plants of the genus *Prunus*: *C. invariabilis* (Braun), *C. melanocarpae* (Braun), and *C. serotinella* (Ely) from North America and *C. zachrysa* (Meyrick) from East Asia: China, Japan, Korea, and Taiwan (De Prins and De Prins, 2018). The nearest neighbor of the Siberian *Caloptilia* sp. in the BOLD database is *C. invariabilis*, with the interspecific distance of 4.9%. The interspecific divergence between the Siberian *Caloptilia* sp., *C. melanocarpae*, and *C. serotinella* reach 11%, while the DNA barcode of *C. zachrysa* is absent in the BOLD and NCBI databases. The adult of *Caloptilia* sp. from Siberia differs from *C. zachrysa* in the forewing pattern and the male genital morphology. The Siberian specimen of *Caloptilia* sp. also differs from the North American *C. melanocarpae* and *C. serotinella* but very closely resembles *C. invariabilis* in the forewing pattern. The male genitalia of the Siberian *Caloptilia* sp. are very similar to those of *C. betulicola*, a Palaearctic species developing on birches; at the same time, the genetic distance between them is 7.7%. The species developing on *Prunus* in Siberia may be new to science; confirming this would require additional sampling in Siberia and comparative morphological and molecular analysis of *C. invariabilis* and *C. betulicola*.

### ****Gracillaria syringella*** (Fabricius, 1794)

Dubatolov, 2013 : 231 (Novosibirsk Province); Baryshnikova, 2014 : 26 (Omsk Province).

**Material.** **Tyumen Province*. Tobolsk, plantings near Ermak Park, *Syringa josikaea*, 25.VI.2015, 7 larvae; same locality, *S. vulgaris*, 25.VI.2015, 5 larvae. **Tomsk Province*. Tomsk, SBG, experimental plot, *Syringa amurensis*, 29.VI.2017, 2 larvae. *Novosibirsk Province*. Novosibirsk, CSBG, *S. vulgaris*, 10.VII.2011, 1 larva, NK57, GRPAL1101-13; same locality, *S. vulgaris*, 11.VII.2011, NK56, GRPAL1100-13, 1 larva [BOLD: AAC0054]; same locality, *S. vulgaris*, 4.VII.2016, 10 larvae; same locality, *Fraxinus excelsior*, 4.VII.2016, 1 larva, NK577, SIBLE066-17. **Altai Territory*. Barnaul, Tselinnikov Park, *S. josikaea*, 29.VII.2017, 3 larvae; same locality, *S. vulgaris*, 29.VII.2017, NK652, SIBLE141-18 [BOLD:AAC0054], 1 larva. **Krasno-*

**Table.** Species of the family Gracillariidae recorded for the first time in the regions of Siberia, based on the authors' collections

| No. | Region | Species recorded for the first time | | References |
|---|---|---|---|---|
| | | in this paper | in our recent publications | |
| 1 | Tyumen Province | *Callisto denticulella, *Gracillaria syringella, *Parornix anglicella | **Micrurapteryx caraganella | Kirichenko et al., 2016 |
| 2 | Khanty-Mansi Autonomous Okrug | *Caloptilia stigmatella, *Parornix anglicella, *Phyllonorycter sorbi | **Phyllonorycter salictella | Kirichenko et al., 2018c |
| 3 | Tomsk Province | **Callisto insperatella, *Caloptilia stigmatella, *Gracillaria syringella, *Parornix anglicella, *Phyllonorycter issikii, *Sauterina hofmanniella | *Phyllocnistis labyrinthella, *Phyllonorycter comparella | Kirichenko et al., 2018c |
| 4 | Omsk Province | **Phyllonorycter pumilae | **Micrurapteryx caraganella | Kirichenko et al., 2016 |
| | | | *Phyllonorycter comparella, **Ph. medicaginella | Kirichenko et al., 2017a |
| | | | *Caloptilia betulicola, *C. populetorum, *C. stigmatella, **Euspilapteryx auroguttella, *Parectopa ononidis, **Phyllonorycter agilella, *Ph. cavella, *Ph. corylifoliella, *Ph. issikii, *Ph. insignitella, *Ph. klemannella, *Ph. pastorella, *Ph. populifoliella, **Ph. schreberella, **Ph. sorbi, *Phyllocnistis extrematrix, *Ph. labyrinthella, *Ph. saligna | Knyazev et al., 2018; Kirichenko et al., 2018c |
| 5 | Novosibirsk Province | **Callisto insperatella, *Caloptilia stigmatella, *Parornix anglicella, *P. scoticella, *Phyllonorycter dubitella, *Ph. emberizaepenella, **Ph. lantanella | **Micrurapteryx caraganella | Kirichenko et al., 2016 |
| | | | *Phyllocnistis saligna, *Ph. labyrinthella | Kirichenko et al., 2018c |
| | | | *Phyllonorycter corylifoliella | Kirichenko et al., 2017d |
| | | | *Phyllonorycter comparella, **Ph. pyrifoliella, **Ph. sorbi | Kirichenko et al., 2017a |
| 6 | Kemerovo Province | *Caloptilia betulicola, *Micrurapteryx caraganella | | |
| 7 | Altai Territory | *Gracillaria syringella, *Parornix anglicella, *Phyllonorycter emberizaepenella, *Ph. ivani, *Ph. sorbi | **Micrurapteryx caraganella | Kirichenko et al., 2016 |
| | | | *Phyllocnistis labyrinthella, *Phyllonorycter comparella | Kirichenko et al., 2018c |
| 8 | Altai Republic | | *Phyllocnistis labyrinthella | Kirichenko et al., 2018c |

**Table.** (Contd.)

| No. | Region | Species recorded for the first time | | References |
|---|---|---|---|---|
| | | in this paper | in our recent publications | |
| 9 | Krasnoyarsk Territory | *_Gracillaria syringella_, *_Parornix anglicella_, *_Phyllonorycter emberizaepenella_, *_Ph. issikii_, *_Ph. sorbi_, **_Ph. viciae_, *_Sauterina hofmanniella_ | *_Caloptilia populetorum_, *_Phyllonorycter salicicolella_, **_Ph. sorbicola_ | Akulov et al., 2018 |
| | | | **_Micrurapteryx caraganella_, *_M. gradatella_, **_Parectopa ononidis_ | Kirichenko et al., 2016 |
| | | | **_Phyllonorycter dubitella_, *_Ph. comparella_, **_Ph. ringoniella_, **_Ph. pyrifoliella_ | Kirichenko et al., 2017a |
| | | | *_Phyllonorycter corylifoliella_ | Kirichenko et al., 2017d |
| | | | *_Phyllocnistis labyrinthella_, ***_Ph. gracilistylella_ | Kirichenko et al., 2018c |
| | | | † _Phyllocnistis verae_ | Kirichenko et al., 2018b |
| | | | † _Phyllonorycter ivani_ | Kirichenko et al., 2019b |
| 10 | Khakassia Republic | ***_Parornix pfaffenzelleri_ | **_Phyllonorycter sorbicola_, **_Phyllocnistis extrematrix_ | Akulov et al., 2018 |
| 11 | Tuva Republic | | **_Micrurapteryx caraganella_, *_Phyllocnistis labyrinthella_, *_Phyllonorycter connexella_ | Kirichenko et al., 2017c |
| | | | *_Phyllonorycter comparella_ | Kirichenko et al., 2017a |
| 12 | Irkutsk Province | **_Phyllonorycter ermani_, **_Ph. pumilae_ | **_Micrurapteryx caraganella_ | Kirichenko et al., 2016 |
| 13 | Buryatia Republic | *_Caloptilia alnivorella_, **_C. suberinella_ | **_Micrurapteryx caraganella_ | Kirichenko and Pustoshinskaya, 2016 |
| | | | *_Phyllocnistis labyrinthella_ | Kirichenko et al., 2018c |
| 14 | Transbaikal Territory | _Caloptilia betulicola_ | **_Micrurapteryx caraganella_ | Kirichenko et al., 2016 |
| | | | † _Phyllonorycter ivani_ | Kirichenko et al., 2019b |
| | Total number of species: | | | |
| | *new to individual regions of Siberia | 15 | 18 | |
| | **new to Siberia as a whole | 6 | 13 | |
| | ***new to Russia | 1 | 1 | |
| | † new to science | – | 2 | |

The specimens, with the exception of some species, were collected by N.I. Kirichenko. The specimens of _Parectopa ononidis_, _Caloptilia betulicola_, _C. populetorum_, _C. stigmatella_, _Euspilapteryx auroguttella_, _Phyllonorycter cavella_, _Ph. insignitella_, _Ph. issikii_, _Ph. klemannella_, _Ph. pastorella_, _Ph. populifoliella_, _Phyllocnistis extrematrix_, and _Ph. labyrinthella_ in Omsk Province were collected by S.A. Knyazev and V.V. Rogalev (Knyazev et al., 2018); those of _Parornix pfaffenzelleri_ in Khakassia and _Phyllonorycter issikii_ in Krasnoyarsk Territory were collected by E.N. Akulov (this paper). * species new to the given region of Siberia; ** species new to Siberia as a whole; *** species new to Russia; † species new to science.

*yarsk Territory*. Krasnoyarsk, Akademgorodok, lower zone, yard plantings, *S. vulgaris*, 25.VI.2009, 3 larvae; same locality, Sukachev Institute of Forest SB RAS, *S. josikaea*, 6.VII.2011, 2 larvae.

Oligophage on Oleaceae: *Chionanthus*, *Forestiera*, *Forsythia*, *Fraxinus*, *Jasminum*, *Ligustrum*, *Osmanthus*, *Phillyrea*, *Syringa* (Ellis, 2018). We observed significant damage by *G. syringella* on *Syringa* in the urban plantings of Tobolsk, Novosibirsk, and Barnaul in 2016–2017.

Subfamily PARORNICHINAE
Kawahara et Ohshima, 2016

***Callisto denticulella*** (Thunberg, 1794)

**Material.** **Tyumen Province*. Tyumen, Zagorodny garden, *Malus* sp., 30.VI.2013, 1 larva, NK91, GRAS001-13, BOLD:AAK2080.

Mostly monophage on *Malus* sp. (Rosaceae); rarely feeds on *Cotoneaster*, *Crataegus*, *Pyrus* (Ellis, 2018).

****Callisto insperatella*** (Nickerl, 1864)

**Material.** *Tomsk Province*. Tomsk, Kurlek, Kedr research station, *Prunus padus*, 27.VI.2017, 1 larva, NK639, SIBLE128-18. *Novosibirsk Province*. Novosibirsk, CSBG, *P. padus*, 4.VII.2016, 1 larva, NK573, SIBLE062-17; same locality, *Prunus virginiana*, 4.VII.2016, 1 larva, NK574, SIBLE063-17 [BOLD: AAK2078].

Monophage on *Prunus* (De Prins and De Prins, 2018; Ellis, 2018); *Prunus virginiana* is recorded here for the first time as the host plant.

***Parornix anglicella*** (Stainton, 1850)

Akulov et al., 2018 : 123 (Krasnoyarsk Territory).

**Material.** **Tyumen Province*. Tyumen, Zatyumensky Park, *Sorbus aucuparia*, 24.VII.2015, 1 larva, NK500, MICRU055-15, BOLD:ABV8044. **Khanty-Mansi Autonomous Okrug*. Surgut, SurSU, Energetikov Park, *Crataegus* sp., 1.VII.2017, 1 larva, NK645, SIBLE134-18; same locality, *Sorbus aucuparia*, 01.VII.2017, 1 larva, NK647, SIBLE136-18 [BOLD:AAL3861]. **Tomsk Province*. Tomsk, SBG, experimental plot, *Crataegus maximowiezii*, 29.VI.2017, 1 larva, NK643, SIBLE132-18, BOLD:ABV8044. **Novosibirsk Province*. Novosibirsk, CSBG, *Amelanchier* sp., 21.VII.2015, 1 larva, NK492, MICRU047-15; same locality, *Crataegus chlorosarca*, 04.VII.2016, 1 larva, NK575, SIBLE064-17, BOLD:AAL3861. **Altai Territory*. Barnaul, Zmeinogorsky road, pine forest, *Sorbus aucuparia*, 29.VII.2017, 1 larva, NK651, SIBLE140-18. *Krasnoyarsk Territory*. Krasnoyarsk, Trostentsovo station, plantings near dacha, *Amelanchier* sp., 4.VII.2015, 2 larvae, NK460, MICRU015-15, NK489, MICRU044-15; Krasnoyarsk, Central recreation park, *Malus* sp., 14.VII.2015, 1 larva, NK490, MICRU045-15 [BOLD:ABZ6947].

Oligophage on Rosaceae: *Crataegus*, less frequently on *Amelanchier*, *Cotoneaster*, *Fragaria*, *Mespilus*, *Rubus*, *Sorbus* (De Prins and De Prins, 2018; Ellis, 2018). *Crataegus chlorosarca* and *C. maximowiezii* are recorded here for the first time as the host plants.

**Remarks.** The above specimens were identified in the genetic databases as *P. anglicella* but assigned to three different BINs: BOLD:ABZ6947 (Geiger et al., 2016), BOLD:AAL3861, and BOLD:ABV8044 (Huemer and Hebert, 2016). The minimal distances between them are 2.2% (BOLD:ABZ6947 and BOLD:AAL3861) and 5.4% (BOLD:ABZ6947 and BOLD:ABV8044; BOLD: AAL3861 and BOLD:ABV8044). The taxonomy of this complex and the threshold of intraspecific genetic variation within it require further study.

***Parornix betulae*** (Stainton, 1854)

Kirichenko et al., 2017d : 97 (Krasnoyarsk Territory); Knyazev et al., 2018 : 266 (Omsk Province).

**Material.** **Tomsk Province*. Tomsk, Lagerny garden, *Betula pendula*, 28.VI.2017, 1 larva, K642, SIBLE131-18. *Novosibirsk Province*. Novosibirsk, CSBG, *B. microphylla*, 13.VII.2012, 1 larva, NK78, GRPAL1122-13 [BOLD:AAE3418]; same locality, *B. pendula*, 13.VI.2012, 1 larva, NK61, GRPAL1105-13; same locality, *B. costata*, 14.VI.2012, 1 larva, NK60, GRPAL1104-13 [BOLD: ABZ4246].

Monophage on *Betula* (De Prins and De Prins, 2018; Ellis, 2018).

**Remarks.** The above specimens were identified in the genetic databases as *Parornix betulae* and belong to two different BINs: BOLD:AAE3418 (Landry et al., 2013; Huemer and Hebert, 2016) and BOLD:ABZ4246 (Huemer et al., 2014b), with the minimal genetic distance between these BINs 2.5%. The taxonomy of this species complex requires further study.

******Parornix pfaffenzelleri*** (Frey, 1856)

**Material.** *Khakassia*. Chernoe Ozero, research station of Sukachev Institute of Forest, SB RAS, to light, 16.VII.2018 (coll. E.A. Akulov, det. P. Triberti), 1 ♂.

Oligophage on Rosaceae: *Amelanchier*, *Cotoneaster*, *Sorbus* (De Prins and De Prins, 2018).

**Remarks.** In the wing pattern, this species resembles the members of the genus *Callisto* in which it was earlier placed; however, the species was recently transferred into the genus *Parornix* based on the characteristic features of the male and female genitalia (Nel and Varenne, 2015). In the structure of the male and female genitalia, *P. pfaffenzelleri* is very close to *P. devoniella* (Stainton). Unlike in the latter species, the saccus in the male genitalia of *P. pfaffenzelleri* is not spatulate while the socii are present; the female genitalia have a simple, non-protruding sterigma.

****Parornix scoticella*** (Stainton, 1850)

**Material.** *Novosibirsk Province*. Novosibirsk, CSBG, *Amelanchier* sp., 4.VII.2016, 1 larva, NK568, SIBLE057-17, BOLD:AAL3871.

Oligophage on Rosaceae: *Cotoneaster*, *Cydonia*, *Dryas*, *Malus*, *Sorbus* (De Prins and De Prins, 2018; Ellis, 2018). *Amelanchier* sp. is recorded here for the first time as the host plant.

***Parornix*** sp.

**Material.** *Transbaikal Territory*. Chita, Park Pobedy, *Malus* sp., 20.VI.2016, 2 larvae, NK559, SIBLE048-17, NK560, SIBLE049-17 [BOLD:ADF3191].

**Remarks.** The specimen from Chita could not be identified to species in the BOLD database. The Palaearctic fauna comprises six species of *Parornix* developing on *Malus*: *P. anguliferella* (Zeller), *P. fumidella* Kuznetzov, *P. maliphaga* Kuznetzov, *P. multimaculata* (Matsumura), *P. petiolella* (Frey), and *P. scoticella* (De Prins and De Prins, 2018). The DNA barcode of the specimen from Chita differs considerably from the sequences of *P. scoticella* and *P. petiolella*, with the minimal interspecific genetic distances of 9.1% and 13.1%, respectively. The sequences of *P. fumidella*, *P. maliphaga*, and *P. multimaculata* are absent in the genetic databases. *Parornix fumidella* and *P. maliphaga* are known from Transbaikal Territory in Siberia, the Russian Far East, and Central Asia (Baryshnikova, 2008; De Prins and De Prins, 2018), and *P. multimaculata* occurs in East Asia: the Russian Far East, Japan, and Korea (De Prins and De Prins, 2018). The specimens from Chita may belong to *P. fumidella*, *P. maliphaga*, *P. multimaculata*, or represent a new species. Additional sampling is needed to clarify the species.

Subfamily LITHOCOLLETINAE Stainton, 1854

***Phyllonorycter agilella*** (Zeller, 1846)

Knyazev et al., 2018 : 267 (Omsk Province).

**Material.** *Omsk Province*. Omsk, Park Pobedy, *Ulmus laevis*, 23.VII.2015, 1 larva, NK498, MICRU053-15, BOLD:AAH8474.

Monophage on *Ulmus* (De Prins and De Prins, 2018).

***Phyllonorycter apparella*** (Herrich-Schäffer, 1855)

Akulov et al., 2018: 123 (Krasnoyarsk Territory); Knyazev et al., 2018 : 267 (Omsk Province); Kirichenko et al., 2018c : 684 (Tyumen, Omsk, Novosibirsk provinces, Altai and Krasnoyarsk territories).

**Material.** *Novosibirsk Province*. Novosibirsk, CSBG, *Populus tremula*, 4.VIII.2011, 1 pupa, NK77, GRPAL 1121-13, BOLD:ACF1321. *Altai Territory*. Barnaul, suburb, *P. tremula*, 23.VII.2012, 1 pupa, NK76, GRPAL 1120-13; same locality, Zmeinogorsky road, pine forest, *P. tremula*, 29.VII.2017, 1 pupa, NK649, SIBLE138-18 [BOLD:ACF1321].

Monophage on *Populus* (Ellis, 2018). We observed numerous mines of *Ph. apparella* on *P. tremula* in the suburbs of Novosibirsk (2011) and Barnaul (2012).

***Phyllonorycter comparella*** (Duponchel, 1843)

Kirichenko et al., 2017a : 5 (Omsk and Novosibirsk provinces, Krasnoyarsk Territory, Tuva); Kirichenko et al., 2018c : 684 (Tomsk Province, Altai Territory).

**Material.** *Krasnoyarsk Territory*. Krasnoyarsk, Akademgorodok, *Populus alba*, 21.VI.2012, 1 pupa, NK67, GRPAL1111-13; same locality, *P. alba*, 28.VI.2012, 1 larva, NK66, GRPAL1110-13 [BOLD: AAD4850]; same locality, Udachny, roadside plantings, *Populus alba*, 7.VII.2015, 10 larvae, 5 pupae, 4 ♂, 3 ♀ (adults reared from leaf mines). *Tuva*. Kyzyl, National park, *P. alba*, 12.VII.2016, 1 larva, 1 pupa.

Monophage on *Populus* (De Prins and De Prins, 2018; Ellis, 2018). We observed numerous mines of the moth on *P. alba* in the suburb of Krasnoyarsk in 2015–2018.

### ***Phyllonorycter connexella*** (Zeller, 1846)

Kirichenko et al., 2017c : 143 (Tuva); Akulov et al., 2018 : 123; Kirichenko et al., 2018c : 684 (Khakassia).

**Material.** *Khakassia*. Abakan, Recreation park, on *Salix* sp., 11.VI.2016, 1 larva, NK554, SIBLE043-17, BOLD:AAD9951.

Oligophage on *Populus* and *Salix* (Salicaceae) (De Prins and De Prins, 2018; Ellis, 2018).

### ***Phyllonorycter corylifoliella*** (Hübner, 1796)

Kirichenko et al., 2017d : 97 (Omsk and Novosibirsk provinces, Krasnoyarsk Territory); Knyazev et al., 2018 : 267 (Omsk Province).

**Material.** *Novosibirsk Province*. Novosibirsk, CSBG, *B. pendula*, 10.VII.2012, 1 larva, NK69, GRPAL1113 -13; same locality, *Betula* sp., 14.VII.2012, 1 larva, NK70, GRPAL1114-13; same locality, *Ulmus laevis*, 4.VIII.2011, 1 larva, NK59, GRPAL1103-13. *Krasnoyarsk Territory*. Krasnoyarsk, Trostentsovo station, *B. pendula*, 10.VII.2011, 1 larva, NK68, GRPAL1112-13 [BOLD:AAA9517].

Polyphage on Betulaceae (*Betula*), Elaeagnaceae (*Hippophae*), and Rosaceae (*Amelanchier*, *Chaenomeles*, *Cotoneaster*, *Crataegus*, *Cydonia*, *Malus*, *Mespilus*, *Prunus*, *Pyrus*, *Sorbus*, *Spiraea*) (De Prins and De Prins, 2018; Ellis, 2018). We recorded a single case of leaf mining on *Ulmus laevis* (Ulmaceae).

### ****Phyllonorycter dubitella*** (Herrich-Schäffer, 1855)

Kirichenko et al., 2017a : 5–6; Akulov et al., 2018 : 123 (Krasnoyarsk Territory).

**Material.** **Novosibirsk Province*. Novosibirsk, CSBG, *Salix caprea*, 4.VII.2016, 1 larva, NK570, SIBLE059-17, BOLD:AAD1181. *Krasnoyarsk Territory*. Krasnoyarsk, Trostentsovo station, dacha, *Salix caprea*, 17.VII.2016, 1 ♀ (adult reared from leaf mine).

Monophage on *Salix* (De Prins and De Prins, 2018; Ellis, 2018).

### ****Phyllonorycter emberizaepenella*** (Bouche, 1834)

**Material.** **Novosibirsk Province*. Novosibirsk, CSBG, *Lonicera tatarica*, 10.VIII.2009, 3 empty leaf mines; same locality, *L. tatarica*, 5.VIII.2013, 3 larvae, 2 pupae, 1 ♂ (adult reared from leaf mine). **Altai Territory*. Barnaul, Izumrudny Park, *L. tatarica*, 27.VII.2015, 2 larvae. **Krasnoyarsk Territory*. Krasnoyarsk, suburb, arboretum of Sukachev Institute of Forest, SB RAS, *L. tatarica*, 20.VI.2009, 1 larva; Krasnoyarsk, Trostentsovo station, pine forest, *L. caerulea*, 23.VII.2017, 1 larva, NK617, SIBLE106-18, BOLD:AAF6919.

Oligophage on Caprifoliaceae: *Leycesteria*, *Lonicera*, *Symphoricarpos* (De Prins and De Prins, 2018; Ellis, 2018).

### *****Phyllonorycter ermani*** (Kumata, 1963)

**Material.** *Irkutsk Province*. Irkutsk, Listvyanka, Baikal astrophysical observatory, pine forest with admixture of deciduous trees, *Alnus alnobetula* subsp. *fruticosa*, 07.VIII.2015, 1 larva, NK483, MICRU038-15, BOLD:ACU5862.

Oligophage on Betulaceae: *Alnus maximowiczii*, *Betula ermanii* (De Prins and De Prins, 2018). *Alnus alnobetula* subsp. *fruticosa* is recorded here for the first time as the host plant.

**Remark.** The DNA barcode of *Ph. ermani* was obtained for the first time and published as reference sequence in the BOLD database.

### ****Phyllonorycter issikii*** (Kumata, 1963)

Kirichenko, 2013 : 813 (Novosibirsk Province), Kirichenko et al., 2017b : 3 (Tyumen and Kemerovo provinces, Altai Territory); Knyazev et al., 2018 : 268 (Omsk Province).

**Material.** *Tyumen Province*. Tyumen, Semen Patsko public garden, *Tilia cordata*, 30.VI.2013, 1 larva, NK200, ISSIK064-14. *Omsk Province*. Omsk, Park Pobedy, *T. cordata*, 23.VII.2015, 2 pupae. **Tomsk Prov-*

*ince*. Tomsk, Tomsk State University, roadside plantings, *T. cordata*, 26.VI.2017, 1 larva, NK635, SIBLE124-18; same locality, SBG, experimental plot, *T. cordata*, 29.VI.2017, 3 larvae. *Novosibirsk Province*. Novosibirsk, CSBG, *T. cordata*, 15.VI.2011, 1 larva, NK16, ISSIK016-12; same locality, *T. cordata*, 20.VIII.2013, 1 ♂ (adult reared from leaf mine), NK143, ISSIK188-14; same locality, *T. cordata*, 31.VII.2017, 5 larvae, 2 pupae. *Kemerovo Province*. Kuzedeevo, lime grove, *T. sibirica*, 24.VI.2013, 1 larva, NK279, ISSIK238-14. *Altai Territory*. Barnaul, arboretum of Siberian Research Institute for Horticulture, *Tilia americana*, 26.VI.2013, 2 larvae; same locality, *Tilia amurensis*, 26.VI.2013, 1 larva, NK195, ISSIK059-14; same locality, *T. cordata*, 26.VI.2013, 1 larva, NK197, ISSIK061-14 [BOLD: AAC9940]; Zmeinogorsky road, pine forest, *T. cordata*, 29.VII.2017, 2 larvae, 1 pupa, NK-107-17. **Krasnoyarsk Territory*. Krasnoyarsk, Akademgorodok, *T. cordata*, 2.IX.2018, 2 leaf mines on leaf, 1 pupal exuvia (E.I. Akulov leg.).

Monophage on *Tilia* (De Prins and De Prins, 2018). We observed high density of leaf mines of *Ph. issikii* in the plantings of Novosibirsk (2011–2017) and Tomsk (2017) and in the suburb of Barnaul (2017).

### *Phyllonorycter ivani* Kirichenko, Triberti et Lopez-Vaamonde, 2019

Kirichenko et al., 2019b : 23–28, species description (Krasnoyarsk Territory); also recorded for Transbaikal Territory. The new species is distinguished by a combination of morphological and molecular characters.

**Material.** *Altai Territory*. Barnaul, Zmeinogorsky road, *Caragana arborescens*, 26.VII.2017, 1 larva, 1 leaf mine, NK-B-1.

### *****Phyllonorycter lantanella*** (Schrank, 1802)

**Material.** *Novosibirsk Province*. Novosibirsk, CSBG, *Viburnum lantana*, 3.VIII.2011, 1 larva, NK71, GRPAL 1115-13, BOLD:AAP7361.

Monophage on *Viburnum* (Adoxaceae) (De Prins and De Prins, 2018).

### ***Phyllonorycter medicaginella*** (Gerasimov, 1930)

Kirichenko et al., 2017a : 6 (Omsk Province); Akulov et al., 2018 : 124 (Krasnoyarsk Territory).

**Material.** *Omsk Province*. Omsk, Park Pobedy, *Medicago* sp., 23.VII.2015, 1 larva, NK482, MICRU037-15, BOLD:AAE0106.

Oligophage on Fabaceae: *Medicago*, *Melilotus*, *Ononis*, *Trifolium*, rarely *Vicia* (Ellis, 2018).

### ***Phyllonorycter pastorella*** (Zeller, 1846)

Akulov et al., 2018 : 124 (Khakassia); Knyazev et al., 2018 : 268 (Omsk Province); Kirichenko et al., 2018c : 684 (Khanty-Mansi Autonomous Okrug, Tomsk Province, Tuva and Buryatia republics).

**Material.** *Khanty-Mansi Autonomous Okrug*. Surgut, SurSU, Energetikov Park, *Salix alba*, 1.VII.2017, 1 larva. *Tyumen Province*. Tobolsk, downtown, Ermak Park, on trunk of *Populus balsamifera*, 25.VII.2015, 1 ♂, NK509, MICRU064-15. *Omsk Province*. Omsk, Park Pobedy, *Salix* sp., 23.VII.2015, 1 larva, NK493, MICRU048-15. *Tomsk Province*. Tomsk, Kurlek, Kedr research station, *Salix* sp., 27.VI.2017, 1 larva, NK636, SIBLE125-18; Lagerny garden, *Salix* sp., 28.VI.2017, 1 larva, NK-34-17; SBG, experimental plot, *Salix fragilis*, 1 larva, 29.VI.2017. *Novosibirsk Province*. Novosibirsk, CSBG, *Salix* sp., 4.VII.2016, 1 larva, NK571, SIBLE060-17. *Altai Territory*. Barnaul, Tselinnikov Park, *Salix* sp., 29.VII.2017, 1 larva, NK654, SIBLE143-18. *Krasnoyarsk Territory*. Krasnoyarsk, suburb, left bank of Yenisei River, env. of Borovoe gardener community, Berkut rock, *Salix* sp., 7.VII.2016, 1 larva, NK567, SIBLE056-17. *Khakassia*. Abakan, Recreation park, *Salix* sp., 12.VI.2016, 1 larva, NK588, SIBLE077-17 [BOLD:AAD9785]. *Buryatia*. Ulan-Ude, Memorial Pobedy Park, *Salix* sp., 10.VII.2015, 2 larvae.

Oligophage on Salicaceae: *Chosenia*, *Populus*, *Salix* (De Prins and De Prins, 2018).

### ***Phyllonorycter populifoliella*** (Treitschke, 1833)

Kirichenko and Pustoshinskaya, 2016 : 30 (Buryatia); Kirichenko et al., 2018 : 684 (Tomsk Province, Khakassia, Tuva); Knyazev et al., 2018 : 268 (Omsk Province).

**Material.** *Tyumen Province*. Tyumen, Zatyumensky Park, on trunk of *Populus balsamifera*, 24.VII.2015, 1 ♂, NK507, MICRU062-15. *Tomsk Province*. Tomsk, Tomsk State University, roadside plantings, *P. balsamifera*, 26.VI.2017, 1 larva, NK634, SIBLE123-18; same locality, plantings along Herzen Street, *P. balsamifera*, 27.VI.2017, 1 larva. *Altai Territory*. Barnaul, Izumrudny Park, on *P. balsamifera* trunk, 27.VII.2015, 1 ♂, NK508, MICRU063-15; same locality, Tselinnikov Park, *P. balsamifera*, 29.VII.2017, 1 larva, NK653, SIBLE142-18. *Krasnoyarsk Territory*. Minusinsk, downtown, *P. balsamifera*, 12.VI.2016, 1 larva, NK552, SIBLE041-17. *Irkutsk Province*. Irkutsk, Karl Marx Street, on *P. balsamifera* trunk, 8.VIII.2015, 1 ♂, NK506, MICRU061-15; Shelekhov, Komsomolsky Boulevard, *P. balsamifera*, 18.VI.2016, 2 larvae, NK557, SIBLE046-17, NK564, SIBLE053-17. *Buryatia*. Ulan-Ude, bus station, roadside plantings, on *P. balsamifera* trunk, 10.VII.2015, 1 ♂, NK487, MICRU042-15. *Transbaikal Territory*. Chita, Park Pobedy, on *P. balsamifera* trunk, 11.VIII.2015, 1 ♀, NK486, MICRU041-15 [BOLD:AAD8619].

Monophage on *Populus* (De Prins and De Prins, 2018). We observed high density of *Ph. populifoliella* leaf mines in the plantings of Novosibirsk (2012, 2015), Krasnoyarsk (2009–2018), Irkutsk, Shelekhov, Ulan-Ude, and Chita (2015).

### ***Phyllonorycter pumilae*** (Ermolaev, 1981)

**Material.** *Omsk Province*. Omsk, Park Pobedy, *Ulmus pumila*, 23.VII.2015, 1 larva, NK494, MICRU049-15. *Irkutsk Province*. Irkutsk, Botanical Garden of ISU, *U. pumila*, 07.VIII.2015, 1 larva, NK484, MICRU039-15 [BOLD:ACU6418].

Monophage on *Ulmus pumila* (De Prins and De Prins, 2018).

### ***Phyllonorycter pyrifoliella*** (Gerasimov, 1933)

Kirichenko et al., 2017a : 6 (Novosibirsk, Krasnoyarsk).

**Material.** *Krasnoyarsk Territory*. Krasnoyarsk, suburb, left bank of Yenisei River, env. of Borovoe gardener community, Berkut rock, *Pyrus* sp., 28.VI.2015, 1 larva, NK480, MICRU035-15; same locality, *Malus* sp., 28.VI.2015, 1 larva, NK481, MICRU036-15 [BOLD:ABZ1078].

Monophage, mostly on *Malus*, rarely on *Pyrus* (Ellis, 2018).

### ***Phyllonorycter salictella*** (Zeller, 1846)

Kirichenko et al., 2018c : 684 (Khanty-Mansi Autonomous Okrug).

**Material.** *Khanty-Mansi Autonomous Okrug*. Surgut, SurSU, Energetikov Park, *Salix viminalis*, 1.VII.2017, 1 larva, NK646, SIBLE135-18, BOLD:AAA9516.

Monophage on *Salix* (Ellis, 2018).

### ***Phyllonorycter schreberella*** (Fabricius, 1781)

Knyazev et al., 2018 : 268 (Omsk Province).

**Material.** *Omsk Province*. Omsk, Park Pobedy, *Ulmus glabra*, 23.VII.2015, 1 larva, NK497, MICRU052-15, BOLD:AAH8428.

Monophage on *Ulmus* (De Prins and De Prins, 2018).

### ****Phyllonorycter sorbi*** (Frey, 1855)

Kirichenko et al., 2017a : 10 (Novosibirsk Province); Knyazev et al., 2018 : 269 (Omsk Province).

**Material.** **Khanty-Mansi Autonomous Okrug*. Surgut, SurSU, Khranitelei Surguta Park, *Sorbus* sp., 1.VII.2017, 1 larva, NK-46-17. *Novosibirsk Province*. Novosibirsk, CSBG, *Amelanchier* sp., 4.VII.2016, 1 larva, NK569, SIBLE058-17; same locality, *Prunus padus*, 4.VII.2016, 1 larva, NK572, SIBLE061-17; *Crataegus chlorosarca*, 4.VII.2016, 1 larva, NK576, SIBLE 065-17. **Altai Territory*. Barnaul, Zmeinogorsky road, pine forest, *Cotoneaster melanocarpus*, 29.VII.2017, 1 pupa. **Krasnoyarsk Territory*. Tanzybei, West Sayan foothills, dwarf pine forest, *P. padus*, 17.VI.2017, 1 larva, NK631, SIBLE120-18 [BOLD:AAD5535].

Oligophage on Rosaceae: *Cotoneaster*, *Crataegus*, *Cydonia*, *Malus*, *Prunus*, *Pyrus*, *Sorbus* (De Prins and De Prins, 2018; Ellis, 2018); *Amelanchier* sp., *Sorbocotoneaster pozdnjakovii*, *Prunus virginiana* f. *atropurpureum* (Kirichenko et al., 2017a). *Crataegus chlorosarca* is recorded here for the first time as the host plant.

### ***Phyllonorycter sorbicola*** (Kumata, 1963)

Akulov et al., 2018 : 125 (Krasnoyarsk Territory, Khakassia).

**Material.** *Krasnoyarsk Territory*. Krasnoyarsk, suburb, left bank of Yenisei River, env. of Borovoe gardener community, Berkut rock, *Prunus padus*, 28.VI.2015, 1 larva, NK503, MICRU058-15. *Khakassia*. Abakan, Recreation park, *P. padus*, 12.VI.2016, 1 larva, NK553, SIBLE042-17 [BOLD:ACY3732].

Oligophage on Rosaceae: *Malus*, *Prunus*, *Sorbus* (De Prins and De Prins, 2018).

**Remark.** The species *Ph. sorbicola* is represented in the BOLD database by three BINs: (1) BOLD:ACY3732, (2) BOLD:ACU5756, (3) BOLD:AAY1215. The first BIN corresponds to the DNA barcodes of the specimens from Siberia, the other two, from Japan. The minimal genetic distances between these BINs are 2% (between 1 and 2), 2.6% (2 and 3), and 3.1% (1 and 3). Additional studies are needed to determine the thresholds of intraspecific genetic variation.

***Phyllonorycter ulmifoliella*** (Hübner, 1817)

Kirichenko et al., 2017d : 97 (Kemerovo Province, Buryatia); Akulov et al., 2018 : 125 (Krasnoyarsk Territory); Knyazev et al., 2018 (Omsk Province).

**Material.** *Irkutsk Province*. Shelekhov, Komsomolsky boulevard, *Betula pendula*, 18.VI.2016, 1 larva, NK587, SIBLE076-17, BOLD:ABY9921.

Monophage on *Betula* (De Prins and De Prins, 2018).

****Phyllonorycter viciae*** (Kumata, 1963)

**Material.** *Krasnoyarsk Territory*. Sosnovoborsk, pine forest, *Vicia unijuga*, 7.VIII.2017, 1 larva, NK612, SIBLE101-18, BOLD:ACZ4845.

Oligophage on Fabaceae: *Lathyrus*, *Vicia* (De Prins and De Prins, 2018). *Vicia unijuga* is recorded here for the first time as the host plant. We observed high density of leaf mines of *Ph. viciae* in the suburb of Sosnovoborsk in 2017.

**Remark.** The DNA barcode of *Ph. viciae* was obtained for the first time and published as a reference sequence in the BOLD database.

***Phyllonorycter*** sp.

**Material.** *Krasnoyarsk Territory*. Krasnoyarsk, suburb, left bank of Yenisei River, env. of Borovoe gardener community, Berkut rock, *Crataegus* sp., 28.VI.2015, 1 larva, NK479, MICRU034-15, BOLD:ACK8977.

**Remark.** In the BOLD database, the sample from Krasnoyarsk was assigned a BIN without a species name. Its nearest neighbor with a genetic distance of 1.9% is *Phyllonorycter sorbicola* (Kumata, 1963) from Japan: RMNH.INS.29783, BIN: BOLD:AAY1215. The host plant was not specified for the Japanese specimen. According to the literature, *Ph. sorbicola* develops on *Malus*, *Prunus*, and *Sorbus* (Rosaceae). It remains unknown whether *Ph. sorbicola* can also develop on *Crataegus* and whether our specimen may belong to *Ph. sorbicola*. There are at least 10 species of *Phyllonorycter* developing on hawthorns in the Palaearctic: *Ph. blancardella* (Fabricius), *Ph. corylifoliella*, *Ph. jozanae* (Kumata), *Ph. leucographella* (Zeller), *Ph. macedonica* (Deschka), *Ph. malella* (Gerasimov), *Ph. mespilella* (Hübner), *Ph. oxyacanthae* (Frey), *Ph. sorbi*, and *Ph. turanica* (Gerasimov). The DNA barcodes of all these species excluding *Ph. malella* are available in genetic databases; yet none of them except *Ph. oxyacanthae* were even considered as potential nearest neighbors of our specimen or included in the genetic distance computation in the BOLD engine. The minimal genetic distance between *Phyllonorycter* sp. and *Ph. oxyacanthae* is 2.2%. The latter species is ranked as the second closest to our specimen, after *Ph. sorbicola*. The DNA barcodes of *Ph. malella* are absent in the BOLD database; the species is known from Altai, Central and Middle Asia where it develops on plants of the family Rosaceae including *Crataegus* (De Prins and De Prins, 2018). If *Phyllonorycter* sp. does not show conspecificity with *Ph. sorbicola*, *Ph. oxyacanthae* or *Ph. malella*, it may be a new species. Thus, identification of this moth requires additional sampling in Siberia.

Subfamily ACROCERCOPINAE
Kawahara et Ohshima, 2016

****Sauterina hofmanniella*** (Schleich, 1867)

Knyazev et al., 2019 : 9 (Omsk Province).

**Material.** **Tomsk Province*. Tomsk, Kurlek, Kedr research base, *Lathyrus* sp., 27.VI.2017, 3 larvae, NK-22-17. *Novosibirsk Province*. Novosibirsk, CSBG, *Lathyrus* sp., 04.VII.2016, 2 larvae, NK581, SIBLE070-17, NK582, SIBLE071-17. **Krasnoyarsk Territory*. Krasnoyarsk, Trostentsovo station, pine forest, *Lathyrus gmelinii*, 23.VII.2017, 1 larva, NK616, SIBLE105-18 [BOLD:ACB0756].

Monophage on *Lathyrus* (Ellis, 2018). *Lathyrus gmelinii* is recorded here for the first time as the host plant. We observed high density of mines of *S. hofmanniella* on *Lathyrus* spp. in the suburbs of Novosibirsk (2016) and Krasnoyarsk (2017–2018).

Subfamily PHYLLOCNISTINAE
Herrich-Schäffer, 1857

***Phyllocnistis gracilistylella***
Kobayashi, Jinbo et Hirowatari, 2011

Kirichenko et al., 2018c : 684, 687–688 (first record for Russia: south of Krasnoyarsk Territory).

**Material.** *Krasnoyarsk Territory*. Tanzybei, West Sayan foothills, pine forest, *Salix caprea*, 18.VI.2017, 1 pupa, NK633, SIBLE122-18, BOLD: AAZ7894.

Monophage on *Salix* (Kobayashi et al., 2011).

***Phyllocnistis labyrinthella***
(Bjerkander, 1790)

Kirichenko et al., 2017c: 143 (Tuva); Knyazev et al., 2018 : 269 (Omsk Province); Kirichenko et al., 2018c : 684 (Tomsk, Novosibirsk, Kemerovo provinces, Altai Territory, Altai Republic, Khakassia, Irkutsk Province, Buryatia).

**Material.** *Tomsk Province*. Tomsk, Kurlek, Kedr research base, *Populus alba*, 27.VI.2017, 1 larva, NK637, SIBLE126-18; same locality, SBG, experimental plot, *P. tremula*, 29.VI.2017, 1 pupa, NK644, SIBLE 133-18. *Novosibirsk Province*. Novosibirsk, CSBG, *P. tremula*, 13.VI.2012, NK64, GRPAL1108-13, 14.VI. 2012, 2 larvae, NK63, GRPAL1107-13. *Kemerovo Province*. Kuzedeevo, lime grove, *P. tremula*, 24.VI. 2013, 2 larvae. *Altai Republic*. Chike-Taman Pass, *Populus tremula*, VII.2012, 2 larvae, 1 pupa; Kamlak, Altai Mountain Botanical Garden, *P. tremula*, VII.2012, 2 larvae. *Krasnoyarsk Territory*. Krasnoyarsk, arboretum of Sukachev Institute of Forest, SB RAS, *P. alba*, *P. nigra*, *P. tremula*, VI.2009, 3 larvae; Tanzybei, West Sayan foot, pine forest, *P. tremula*, 17.VI.2017, 1 pupa, NK632, SIBLE121-18. *Khakassia*. Abakan, Recreation park, *P. alba*, 12.VI.2016, 1 larva, NK585, SIBLE074-17; same locality, *P. tremula*, 12.VI.2016, 1 larva, NK586, SIBLE075-17 [BOLD:ACX5473]. *Tuva*. Kyzyl, Botanical Garden of TuvSU, *P. alba*, 13.VII.2016, 10 larvae, 1 pupa. *Irkutsk Province*. Irkutsk, suburb, pine forest with admixture of deciduous trees, *P. tremula*, 7.VIII.2015, 2 larvae.

Monophage on *Populus* (De Prins and De Prins, 2018; Ellis, 2018). We observed high damage caused by *Ph. labyrinthella* to aspen in the suburb of Novosibirsk in 2012, in the West Sayan foothills (Krasnoyarsk Territory), and in planted stands in Kyzyl and Tomsk in 2016 and 2017.

***Phyllocnistis unipunctella*** (Stephens, 1834)

Kirichenko et al., 2018 : 684 (Novosibirsk Province, Altai Territory, Khakassia, Transbaikal Territory).

**Material.** *Novosibirsk Province*. Novosibirsk, CSBG, *Populus nigra*, VIII.2011, 1 pupa; same locality, *P. balsamifera*, VIII.2011, 1 pupa. *Altai Territory*. Barnaul, plantings along Krasnoarmeisky Avenue, *P. balsamifera*, 30.VII.2017, 1 larva. *Buryatia*. Ulan-Ude, 52 Smolina Street, yard plantings, *P. balsamifera*, 10.VII.2015, 1 larva, NK485, MICRU040-15, BOLD:ACI4050; same locality, *P. balsamifera*, 10.VII.2015, 2 ♂ (adults reared from leaf mines). *Transbaikal Territory*, Chita, Park Pobedy, *P. balsamifera*, 11.VIII.2015, 10 larvae, 1 pupa; same locality, *P. balsamifera*, 11.VIII.2015, 3 ♂ (adults reared from leaf mines).

Monophage on *Populus* (De Prins and De Prins, 2018; Ellis, 2018). We observed significant damage caused by this moth species to *P. balsamifera* in the parks of Ulan-Ude and Chita in 2015.

**Remark.** In the BOLD database *P. unipunctella* is represented by three BINs: (1) BOLD:ACI4050, (2) BOLD:AAD7979, and (3) BOLD:ADA1533, which are well differentiated geographically (Jordan et al., 2016). Out sample belongs to the first BIN, while the second and third BINs correspond to DNA barcodes from Europe and Japan, respectively. The minimal genetic distances between the BINs are 4.9% (BIN 1 and 2), 5.5% (2 and 3), and 3.6% (1 and 3). Identification of the specimen from Buryatia was confirmed by genital morphology of the male reared from the same series of leaf mines. Additional research is needed to determine the intra- and interspecific genetic thresholds and morphological variation of this species complex.

***Phyllocnistis verae***
Kirichenko, Triberti et Lopez-Vaamonde, 2018

Kirichenko et al., 2018b : 95–99, species description (Krasnoyarsk Territory).

**Material.** *Krasnoyarsk Territory*. Krasnoyarsk, suburb, left bank of Yenisei River, env. of Borovoe gardener community, Berkut rock, *Cornus alba*, 05.VII.2015, 1 larva, NK463, MICRU018-15; same locality, *C. alba*, 7.VII.2016, 2 larvae, NK518, MICRU073-16, NK519, MICRU074-16 [BOLD:ACX7754].

Monophage on *Cornus alba* (Kirichenko et al., 2018b).

## DISCUSSION

This study, based on use of DNA barcoding, allowed us to identify Gracillariidae specimens collected mainly as larvae and pupae from their leaf mines in Siberia. Although sampling insects on preimaginal stages limits the faunistic coverage of the studied group, it still has a considerable advantage over sampling adult moths. The use of DNA barcoding to identify larvae and pupae collected directly from the mines allowed us to clarify the trophic associations of Gracillariidae in Siberia, which would be impossible through capturing adults. The collection of mines and their inhabitants in urban habitats (botanical gardens and parks) revealed new host plants of Gracillariidae, including some alien woody plant species introduced to Siberia from other regions. Regular examination of non-native plants is essential for discovering the alien insects which have spread together with their host plants from their homeland, and also for detecting the potential pests among the local insects before they spread into the native ranges of these plants (Eschen et al., 2018).

In the phylogenetic tree, all the Gracillariidae species identified from Siberia unambiguously corresponded to six subfamilies which had been previously known from Siberia: Lithocolletinae, Parornichinae, Gracillariinae, Acrocercopinae, Ornixolinae, and Phyllocnistinae (Baryshnikova, 2008). The two remaining subfamilies, Marmarinae and Oecophyllembiinae (Kawahara et al., 2017), are not represented in Siberia.

This study confirms our earlier assumption that upon careful revision of the Gracillariidae fauna in Siberia, it would mainly have species distributed in the West Palaearctic. The Gracillariidae fauna of Siberia is closer to that of European Russia than to that of the Russian Far East. Our earlier study of Gracillariidae developing on willows (family Salicaceae) also showed that the assemblage of such species in Siberia was more similar to the corresponding species assemblage in the west of Russia than to that in the Russian Far East (Kirichenko et al., 2018c). This result is not surprising. Indeed, the Gracillariidae fauna of the Russian Far East has been mostly studied in the south of Primorsky Territory, which differs considerably from the rest of Russia in its history, climate conditions, and composition of the flora and fauna (Krestov, 2003). The evolutionary history of Primorsky Territory is connected with the Sea of Japan region (Makarkin, 1993). Drastic climate changes in the Late Pleistocene and Early Holocene, accompanied by meridional shifts of plant communities and the associated faunas, formed the background for development of the unique biota of the Russian Far East (Grichuk and Borisova, 2009; Novenko, 2009) which presently combines temperate and subtropical elements. Data for a number of taxa show that high biodiversity in the region has been formed both by colonization from the adjacent territories, including East Asian ones, and by autochthonous speciation (Nazarenko, 1990; Beljaev, 1996; Dubatolov and Kosterin, 2000). This was facilitated by repeated marine transgressions and regressions in the Quaternary, which led, on the one hand, to isolation and subsequent divergence of insular populations, and on the other hand, to expansion of the land area and dispersal of species not only over the continent but also over the land bridges. Indeed, the Gracillariidae fauna of the Russian Far East, unlike the faunas of Siberia and European Russia, comprises a considerable number of East Asian species (Kirichenko et al., 2018a).

In this study we revealed the presence in Siberia of 21 species of Gracillariidae which had not been earlier recorded in this macroregion, and also documented wider distribution of some species previously known only from certain parts of Siberia (Baryshnikova, 2008). The distribution of other 34 species of the family was discussed in our recent publications (see table). In most cases, the new findings do not indicate the expansion of Gracillariidae in Siberia but merely confirm the insufficient knowledge of regional faunas and show the need for further research. An exception is the lime leafminer *Phyllonorycter issikii*, an invasive species of East Asian origin (Kirichenko et al., 2017b), which expanded to Siberia in the early XXI century, most probably from the previously invaded European Russia, and still continues spreading. For the first time, the species was documented in Siberia in 2006 in Tyumen Province (Gninenko and Kozlova, 2006). In 2008–2014, the lime leafminer was recorded in Novosibirsk, Omsk, and Kemerovo provinces and in Altai Territory (Kirichenko, 2013; Kirichenko et al., 2017b; Knyazev et al., 2019). According to our recent observations, *Ph. issikii* has spread into Tomsk Province and Krasnoyarsk Territory, the regions that currently represent the northern and eastern distribution boundaries of this pest in Siberia.

Our studies in Siberia are far from being complete. Despite the extensive geographic coverage including 14 administrative regions of Siberia, from Tyumen Province to Transbaikal Territory, collections of Gracillariidae within the regions were patchy, localized, and often restricted to major railway stations. Moreover, our work was focused on the species developing on woody plants, even though some (though much fewer) species of Gracillariidae are trophically associated with herbaceous plants in the Palaearctic (De Prins and De Prins, 2018; Ellis, 2018).

Apart from Irkutsk Province, the fauna of Gracillariidae developing on woody plants is relatively well studied in Omsk Province (Baryshnikova, 2014; Chursina et al., 2016; Kirichenko et al., 2017a; Knyazev et al., 2018), Novosibirsk Province (Dubatolov, 2013; Kirichenko, 2013; Kirichenko et al., 2016, 2017a, 2017b, 2017d, 2018c), and the south of Krasnoyarsk Territory (Yanovsky, 1996, 2003; Tarasova et al., 2004; Kirichenko et al., 2016, 2017a, 2017d, 2018b, 2018c, 2019b; Akulov et al., 2018). Hardly anything is known about Gracillariidae diversity in the northern (Khanty-Mansi and Yamalo-Nenets autonomous okrugs, Tomsk Province, north of Krasnoyarsk Territory, Yakutia Republic) and some southern (Altai Territory, Altai and Tuva republics) and eastern regions (Transbaikal Territory). Our future research using integrative taxonomy methods (Schlick-Steiner et al., 2010) will be focused on Gracillariidae developing on woody and herbaceous plants in these poorly studied Siberian regions.

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