

# ***Formica gagatoides* Ruzsky, 1904 and Siberian *F. kozlovi* Dlussky, 1965 (Hymenoptera: Formicidae); Two or One Species?**

Svetlana V. Chesnokova, Oleg V. Vaulin, Zoya A. Zhigulskaya, Tatiana A. Novgorodova

## **Supplementary materials**

**Table S1.** The main characteristics of the material studied.

<b>Ants species</b>	<b>Place and time of sampling</b>	<b>Number of samples</b>	<b>Number of individuals</b>	<b>Samples used in molecular genetic analysis</b>
<i>F. cf. kozlovi</i>	Russia, Altai Republic, Ust-Koksinsky District, the south macroslope of Katun ridge, 49.62°N 85.85°E, 2200 m a.s.l., grassland tundra, rocky scree, 19.08.2008 [ChS]	2 (1)	11 (10)	–
<i>F. cf. kozlovi</i>	Russia, Altai Republic, Ust-Koksinsky District, the surroundings of Middle Multinskoye lake, 49.98°N 85.85°E, 2200 m a.s.l., grassy tundra with dwarf birch, 29.08.2008 [ChS]	1 (1)	10 (10)	–
<i>F. cf. kozlovi</i>	Russia, Altai Republic, Ongudaisky District, Terektinsky mountain range, 50.38°N 86.33°E, 2000 m a.s.l., larch-cedar woodlands, 27-30.06.2008 [ChS]	3 (3)	28 (28)	–
<i>F. cf. kozlovi</i>	Russia, Altai Republic, Ust-Koksinsky District, the surroundings of Middle Multinskoye lake, 49.98°N 85.83°E, 1900 m a.s.l., spruce-cedar semi-marshy woodlands, 27.08.2008 [ChS]	2 (2)	29 (29)	–
<i>F. cf. kozlovi</i>	Russia, Altai Republic, Ust-Koksinsky District, the surroundings of Middle Multinskoye lake, 49.98°N 85.85°E, 2100 m a.s.l., tall grass woodlands on slopes, 26-28.08.2008 [ChS]	6 (4)	44 (42)	–
<i>F. cf. kozlovi</i>	Russia, Altai Republic, Ust-Koksinsky District, the Krasnaya mountain, 50.08°N 85.22°E, 2020 m a.s.l., dwarf birch tundra, 15-16.07.2019 [NT]	4 (4)	27 (27)	F2-2 (koz/gag), F3-2 (gag)
<i>F. cf. kozlovi</i>	Russia, Altai Republic, Ust-Koksinsky District, the Krasnaya mountain, 50.09°N 85.22°E, 1864 m a.s.l., cedar-larch forest, 17.07.2019 [NT]	1 (1)	17 (17)	F4-2 (koz/gag)
<i>F. cf. kozlovi</i>	Russia, Altai Republic, Ulagansky District, Yoldu River, 50.47°N 88.53°E, 1740 m a.s.l., the river floodplain, 07.07.2019 [NT]	1 (1)	8 (8)	–
<i>F. cf. kozlovi</i>	Russia, Altai Republic, Ulagansky District, Yoldu River, 50.47°N 88.53°E, 1740 m a.s.l.,	1 (1)	7 (7)	–

Ants species	Place and time of sampling	Number of samples	Number of individuals	Samples used in molecular genetic analysis
	cedar-larch forest, 09.07.2019 [NT]			
<i>F. cf. kozlovi</i>	Russia, Altai Republic, Ulagansky District, Yoldu River, 50.83°N 88.95°E, 2100 m a.s.l., cedar-larch forest, 20.06.2005 [NT]	1 (1)	10 (10)	–
<i>F. cf. kozlovi</i>	Russia, Altai Republic, Kosh-Agachsky District, Tara River, 49.65°N 88.22°E, 2200 m a.s.l., larch forest 02.07.2006 [NT]	1 (1)	11 (11)	–
<i>F. cf. kozlovi</i>	Russia, Altai Republic, Kosh-Agachsky District, Tara River, 49.65°N 88.22°E, 2300-2850 m a.s.l., slopes with dwarf birch, 01.07.2006 [NT]	4 (3)	31 (30)	–
<i>F. cf. kozlovi</i>	Russia, Altai Republic, Kosh-Agachsky District, Ukok Plateau, about 8 km to NE from the peak of Maitobe mountain 49.57°N 87.72°E, 2420 m a.s.l., dwarf birch tundra, 08.07.2006 [NT]	2 (2)	21 (21)	–
<i>F. cf. kozlovi</i>	Russia, Altai Republic, Kosh-Agachsky District, the Ukok Plateau, surroundings of Kal'djin-Kol' and Kal'jin-Kol'-Bass lakes 49.32°N 87.43°E, 2400 m a.s.l., dwarf birch tundra, 18.07.2006 [NT]	1 (1)	1 (1)	–
<i>F. cf. kozlovi</i>	Russia, Krasnoyarsk Territory, vicinity of Norilsk, 69.45°N 88.68°E, 100 m a.s.l., larch forest, 08-17.07.2022 [IaI]	5 (4)	34 (27)	F151-1 (koz/gag), F156-1 (koz)
<i>F. cf. kozlovi</i>	Russia, Krasnoyarsk Territory, vicinity of Norilsk, 69.48°N 88.38°E, 70 m a.s.l., larch forest, 04.07.2022 [IaI]	1 (1)	7 (7)	–
<i>F. cf. kozlovi</i>	Russia, Krasnoyarsk Territory, vicinity of Norilsk, nearby Waterfall Red stones, thickets of shrubs, 69.48°N 88.53°E, 100-200 m a.s.l., 15-23.07.2022 [IaI, AG, BO, GA]	3 (2)	12 (11)	F150-1 (koz/gag)
<i>F. cf. kozlovi</i>	Russia, Krasnoyarsk Territory, vicinity of Norilsk, 69.24°N 88.20°E, 153 m a.s.l., bushes and tundra-steppe, 14.07.2022 [LI]	1 (0)	22 (0)	F152-1 (koz/gag)
<i>F. gagatoides</i>	Russia, Altai Republic, Ust-Koksinsky District, the surroundings of Middle Multinskoye lake, 49.98°N 85.85°E, 2100 m a.s.l., tall grass woodlands on slopes, 28.08.2008 [ChS]	1 (1)	16 (16)	–
<i>F. gagatoides</i>	Russia, Altai Republic, Ongudaisky District, Terektinsky mountain range, 50.38°N 86.33°E, 2000 m a.s.l., larch-cedar woodlands,	1 (0)	1 (0)	–

Ants species	Place and time of sampling	Number of samples	Number of individuals	Samples used in molecular genetic analysis
	30.06.2008 [ChS]			
<i>F. gagatoides</i>	Russia, Altai Republic, Ongudai District, surroundings of the Yankol' lake, 50.37°N 86.27°E, 2200 m a.s.l., woodland on the rocky slope, 01.07.2008 [ChS]	1 (1)	5 (5)	–
<i>F. gagatoides</i>	Russia, Altai Republic, Ust-Koksinsky District, the Krasnaya mountain, 50.08°N 85.22°E, 2020 m a.s.l., dwarf birch tundra, 15.07.2019 [NT]	2 (2)	12 (12)	–
<i>F. gagatoides</i>	Russia, Krasnoyarsk Territory, vicinity of Norilsk, 69.47°N 88.57°E, 200 m a.s.l., larch forest, 19.07.2022 [IaI]	1 (0)	1 (0)	–
<i>F. gagatoides</i>	Russia, Krasnoyarsk Territory, vicinity of Norilsk, 69.47°N 88.51°E, 100 m a.s.l., larch forest, 07.07.2022 [IaI]	1 (1)	7 (7)	F153-1 (koz/gag)
<i>F. gagatoides</i>	Russia, Krasnoyarsk Territory, vicinity of Norilsk, nearby Waterfall Red stones, thickets of shrubs, 69.48°N 88.53°E, 200 m a.s.l., 15-23.07.2022 [IaI, AG, BO, GA]	1 (1)	3 (3)	–
<i>F. gagatoides</i>	Russia, Krasnoyarsk Territory, vicinity of Norilsk, 69.45°N 88.68°E, 100 m a.s.l., larch forest, 17.07.2022 [IaI]	1 (1)	8 (8)	–
<i>F. gagatoides</i>	Russia, Murmansk Region, the Khibiny Mountains, 67.65°N 33.53°E, 450-500 m a.s.l., crooked beach forest, 27.06.2014 [ZI, ShI]	2 (0)	2 (0)	–
<i>F. gagatoides</i>	Russia, Murmansk Region, the Khibiny Mountains, 67.65°N 33.53°E, 700 m a.s.l., shrub-lichen tundra, 27.06.2014 [ZI, ShI]	2 (0)	2 (0)	–
<i>F. gagatoides</i>	Russia, Murmansk Region, the Khibiny Mountains, 67.65°N 33.53°E, 730 m a.s.l., moss-lichen tundra, 23.06-4.09.2014 [ZI, ShI]	1 (0)	1 (0)	–
<i>F. gagatoides</i>	Russia, Murmansk Region, the Khibiny Mountains, 67.65°N 33.53°E, 700 m a.s.l., shrub tundra, 16.06.2014 [ZI, ShI]	1 (0)	1 (0)	–
<i>F. gagatoides</i>	Russia, Murmansk Region, the Khibiny Mountains, 67.65°N 33.53°E, 500-600 m a.s.l., dwarf shrub pine forest, 16.06.-7.07.2014 [ZI, ShI]	1 (0)	1 (0)	–
<i>F. gagatoides</i>	Russia, Murmansk Region, Pechenga district, vicinity of town Zapolyarny, 69.44°N 30.78°E, 183 m a.s.l., birch crooked forests shrub-green moss, 02.07.2022, [NT]	1 (0)	2 (0)	–

Ants species	Place and time of sampling	Number of samples	Number of individuals	Samples used in molecular genetic analysis
<i>F. gagatoides</i>	Russia, Murmansk Region, Pechenga district, vicinity of town Zapolyarny, 69.44°N 30.56°E, 264 m a.s.l., birch crooked forests shrub-green moss, 02.07.2022, [NT]	1 (1)	1 (1)	–
<i>F. gagatoides</i>	Russia, Murmansk Region, 16 km SSW from Monchegorsk, 1 km SSE from Majavr mountain, 67.75°N 32.82°E, 372 m a.s.l., birch-spruce green-moss-bilberry forest, 24.06.2022, [NT]	1 (0)	1 (0)	–
<i>F. gagatoides</i>	Russia, Murmansk Region, Pechenga district, 15 km SSW Nickel, E from Shuoniyaur Lake, 69.25°N 30.09°E, 295 m a.s.l., birch crooked forests shrub-green moss, 07.07.2022, [NT]	1 (1)	10 (10)	–
<i>F. gagatoides</i>	Russia, Murmansk Region, 16 km SSW from Monchegorsk, 1 km SSE from Majavr mountain, 67.75°N 32.82°E, 372 m a.s.l., birch-spruce green-moss-bilberry forest, 24.06.2022, [NT]	1 (1)	11 (11)	–
<i>F. gagatoides</i>	Russia, Murmansk Region, Pechenga district, 28,3 km S town Nickel, vicinity of Keudsherjaur Lake, 69.15°N 30.15°E, 341 m a.s.l., birch crooked forests shrub-green moss, 03.07.2022, [NT]	1 (1)	9 (9)	–
<i>F. gagatoides</i>	Russia, Murmansk Region, Pechenga district, vicinity of town Zapolyarny, 69.44°N 30.56°E, 264 m a.s.l., birch crooked forests shrub-green moss, 02.07.2022, [NT]	1 (0)	5 (0)	–
<i>F. gagatoides</i>	Russia, Murmansk Region, Pechenga district, vicinity of town Nickel, 69.39°N 30.19°E, 126 m a.s.l., pine-birch shrub forest with disturbed ground cover, 02.07.2022, [NT]	1 (0)	2 (0)	–
<i>F. gagatoides</i>	Russia, Murmansk Region, vicinity of the Kuets'jarvi lake, 69.43°N 30.22°E, 143 m a.s.l., pine-birch forest, 04.07.2022, [NT]	2 (1)	50 (15)	F148-1 (gag), F149-1 (koz/gag)
<i>. gagatoides</i>	Russia, Magadan Region, Severo-Evensky District, Garmanda village, 62.17°N 159.07°E, 149 m a.s.l., tundra, 16.07.2020 [TrN]	1 (0)	10 (0)	F20-1 (gag)
<i>F. gagatoides</i>	Russia, Magadan Region, Severo-Evensky District, 3 km to N from Garmanda village, 62.2°N 159.1°E, 180 m a.s.l., bank of a stream with meadows and shrubs, 14.07.2020 [TrN]	1 (0)	1 (0)	F21-1 (koz/gag)

Ants species	Place and time of sampling	Number of samples	Number of individuals	Samples used in molecular genetic analysis
<i>F. gagatoides</i>	Russia, Magadan Region, Koni peninsula, forest cordon Plosky, 59.15°N 151.63°E, 220 m a.s.l., cedar elfin with meadows along river terraces, 01-06.07.2017 [SV]	1 (0)	3 (0)	–
<i>F. gagatoides</i>	Russia, Magadan Region, Tenkinsky District, Madaun village, 60.61°N 150.7°E, 520 m a.s.l., sparse larch forest, 13.08.2019 [ZhZ]	1 (1)	4 (4)	F1-2 (gag)
<i>F. gagatoides</i>	Russia, Magadan Region, Yagodninsky District, 16 to SE from Yagodnoe village, 62.42°N 149.82°E, 430 m a.s.l., the bank of Debin River, 03.06.2021 [BN]	1 (1)	25 (25)	F26-1 (gag)
<i>F. gagatoides</i>	Russia, Magadan Region, Olsky District, Ola village 59.58°N 151.3°E, 10 m a.s.l., sparse larch forest along sea bank, 06.06.2021 [ZhZ]	1 (1)	3 (3)	F27-1 (gag)
<i>F. gagatoides</i>	Russia, Magadan Region, Yanskies lakes, 59.76°N 149.51°E, 5 m a.s.l., dam slope, 09.06.2021 [ZhZ]	2 (2)	62 (62)	F28-1 (gag)
<i>F. gagatoides</i>	Russia, Magadan Region, Tenkinsky District, research base 'Aborigine', 61.94°N 149.67°E, 450 m a.s.l., sparse larch woodland coupled with moss-lichen cover on the northern slope, 12.06.1983 [ZhZ]	1 (0)	10 (0)	–
<i>F. gagatoides</i>	Russia, Magadan Region, Tenkinsky District, research base 'Aborigine', 61.94°N 149.67°E, 450 m a.s.l., sparse larch woodland, 16.07.1984 [ZhZ]	1 (0)	8 (0)	–
<i>F. gagatoides</i>	Russia, Magadan Region, Tenkinsky District, Vakhanka River, 61.41°N, 149.40°E, 500 m a.s.l., meadow on the slope, 1980. [ZhZ]	1 (0)	10 (0)	–
<i>F. aff. candida</i>	Russia, Magadan Region, Tenkinsky District, Madaun village, 60.61°N 150.7°E, 520 m a.s.l., sparse larch forest, 13.08.2019 [ZhZ]	2 (2)	5 (5)	F5-2, F6-2
<i>F. aff. candida</i>	Russia, Magadan Region, 11 km to SW from the Sokol village, 59.9°N 150.78°E, 115 m a.s.l., field in the Khasin river valley, 05.08.2020 [TrN]	1 (0)	1 (0)	F23-1
<i>F. lemani</i>	Russia, Magadan, Marchekanskaya Sopka, 59.51°N 150.82°E, 600 m. a.s.l., steppe slope, 20.10.2019 [ZhZ]	1 (1)	3 (3)	F7-2
<i>F. lemani</i>	Russia, Magadan Region, Khasynsky District, Stekol'niy village, a rocky shoulder of the old highway, 60.05°N 150.74°E, 230 m a.s.l., a	1 (1)	3 (3)	F8-1

Ants species	Place and time of sampling	Number of samples	Number of individuals	Samples used in molecular genetic analysis
	rocky roadside of an old highway, 13.08.2019 [ZhZ]			
<i>F. lemani</i>	Russia, Magadan Region, Magadan city suburb, Magadan, 59.58°N 150.83°E, 600 m a.s.l., a clearing in a larch forest, 26.09.2019 [ZhZ]	1 (1)	3 (3)	F9-2
<i>F. lemani</i>	Russia, Murmansk Region, bank of the Blyudce lake, 69.18°N 33.28°E, 50 m a.s.l., tundra landscape, 09.07.2020 [VE]	1 (1)	3 (3)	F18-1
<i>F. lemani</i>	Russia, Murmansk Region, Vicinty of Gadzhievo town, 69.26°N 33.32°E, 53 m a.s.l., tundra landscape, 23.07.2020 [VE]	1 (1)	3 (3)	F19-1
<i>F. lemani</i>	Russia, Novosibirsk Region, Karasuk District, the vicinity of Scheinfeld village, 53.66°N 77.48°E, 110 m a.s.l., aspen-birch forest plot in the forest-steppe, 22.09.2020 [NT]	1 (1)	30 (3)	F24-1

Note. The collectors of the material are indicated in square brackets: ChS – Chesnokova S.V., NT – Novgorodova T.A., ZI – Zenkova I.V., ShI – Shtabrovskaya I.M., TrN – Tridrikh N.N., SV – Sorokina V.S., ZhZ – Zhigulckaya Z.A., BN – Bulakhova N.A., VE – Vaulin E.V., IaI – Iakovlev I.K., AG – Azarkina G.N., BO – Buleu O.G., GA – Gurina A.A., LI – Lyubechanskii I.I. The number of samples/individuals collected from ant nests is given in parentheses. Morphotypes: gag – *F. gagatoides*, koz – *F. kozlovi*, koz/gag – ‘mixed’ *F. kozlovi/gagatoides*.

**Table S2.** An origin of the sequences from DNA database. The sequences of DNA identified as *F. gagatooides* and Canadian sequences of *Formica* spp. similar to COI of *F. gagatooides* from NCBI nucleotide database.

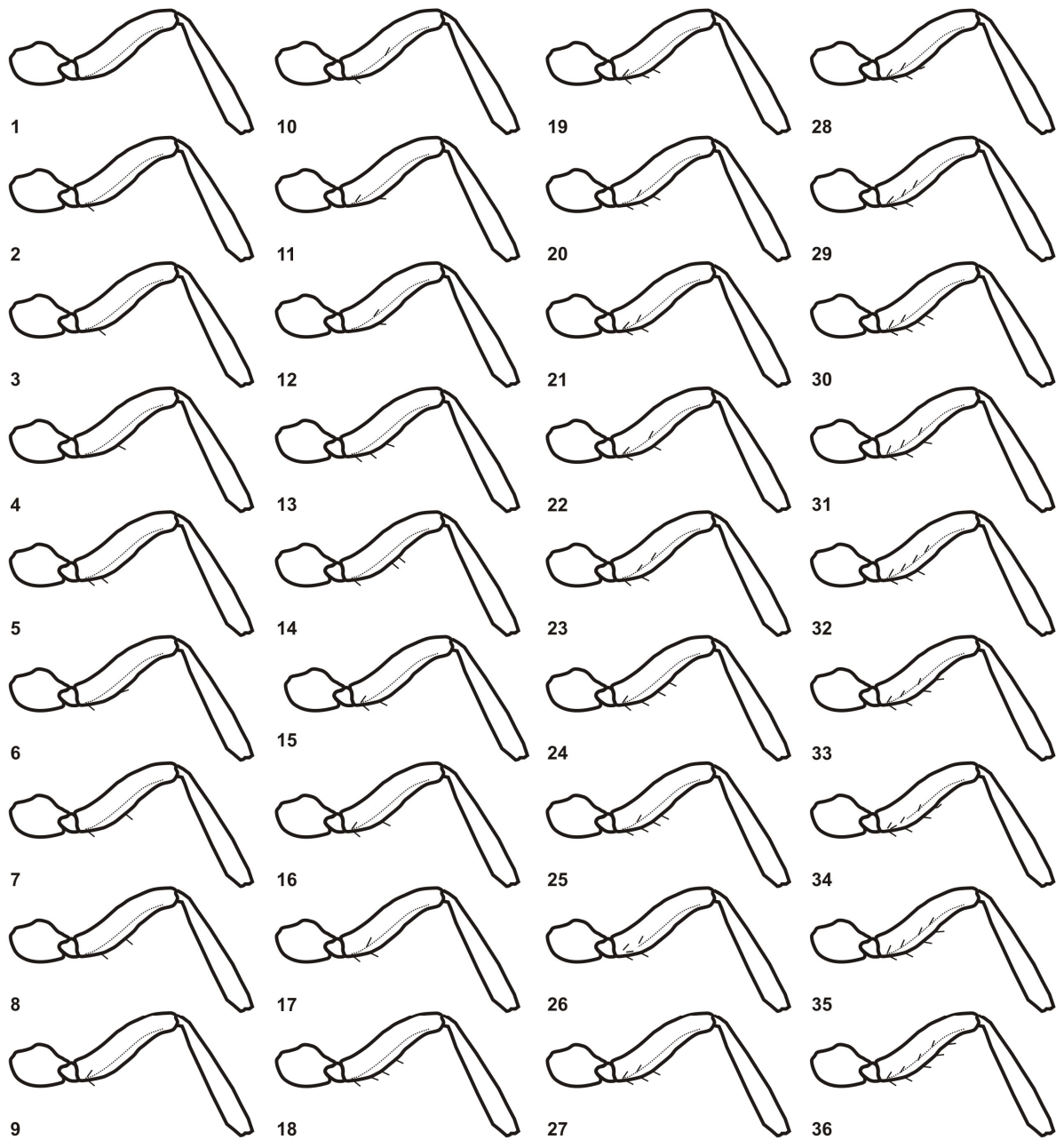
Original designation / ant species	DNA database number			Region
	COI	ITS1	D2 28S rDNA	
NX001 / <i>F. gagatooides</i>	KX665068	KX609305	–	Ningxia province, Central China [24]
NX002 / <i>F. gagatooides</i>	KX665069	KX609306	–	Ningxia province, Central China [24]
NX003 / <i>F. gagatooides</i>	KX665070	KX609307	–	Ningxia province, Central China [24]
NX005 / <i>F. gagatooides</i>	KX665071	KX609308	–	Ningxia province, Central China [24]
SHX002 / <i>F. gagatooides</i>	KX665072	KX609309	–	Shaanxi province Central China [24]
2008_6_030 / <i>F. gagatooides</i>	HQ619703	–	–	Ningxia province, Central China (Direct submission in GenBank)
RS 3690 / <i>F. gagatooides</i>	MZ611315	–	–	Lapland Region, Finland [42]
RVcoll16B242 / <i>F. gagatooides</i>	LT977396	–	–	Troms og Finnmark Fylke, Norway [13]
RVcoll17S279 / <i>F. gagatooides</i>	LT977398	–	LT977165	Trondelag Fylke, Norway [13]
RVcoll17S548 / <i>F. gagatooides</i>	LT977397	–	–	Kamchatka Territory, Russia [13]
RVcoll17S206 / <i>F. gagatooides</i>	LT977399	–	LT977164	Kamchatka Territory, Russia [13]
CHU06-ANT-242 / <i>F. cf. neorufibarbis</i> 2	FJ413256	-	-	Manitoba, Canada [41]
YUKIN-0418 / <i>F. fusca complex</i>	HQ569283	-	-	Yukon, Canada (Direct submission in GenBank)
BIOUG00740-A09 / <i>Formica</i> sp.	JX829423	-	-	Manitoba, Canada [40]

Note to Table S2: References [13,24,36,40-42] are cited in the main text.

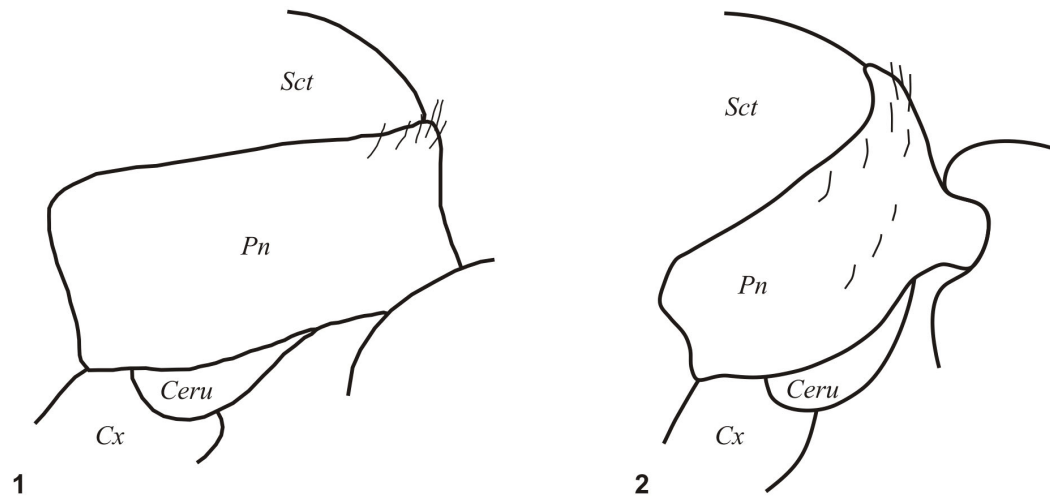
**Table S3.** The main types of pubescence of I-III gaster tergites of studied specimens of *F. gagatoides*/*F. cf. kozlovi* complex according to the ratio of the length of the pubescence hairs and the distance between them.

<b>Tergite (1st or 2nd half)</b>	<b>Type 1 (similar to <i>F. gagatoides</i>)</b>	<b>Type 2 (typical of <i>F. gagatoides</i>)</b>	<b>Type 3 (similar to <i>F. kozlovi</i>)</b>	<b>Type 4 (typical of <i>F. kozlovi</i>)</b>
I (1)	1.6 – 1.7	1.1 – 1.2	0.9 – 1.0	0.5 – 0.7
I (2)	1.6 – 1.7	0.8 – 1.0	0.7 – 0.8	0.5 – 0.6
II (1)	1.1 – 1.2	0.7 – 0.8	0.6 – 0.7	0.5 – 0.6
II (2)	0.8 – 1.0	0.7 – 0.8	0.6 – 0.7	0.5 – 0.6
III (1)	0.7 – 0.8	0.7 – 0.8	0.6 – 0.7	0.5 – 0.6
III (2)	0.7 – 0.8	0.7 – 0.8	0.6 – 0.7	0.5 – 0.6

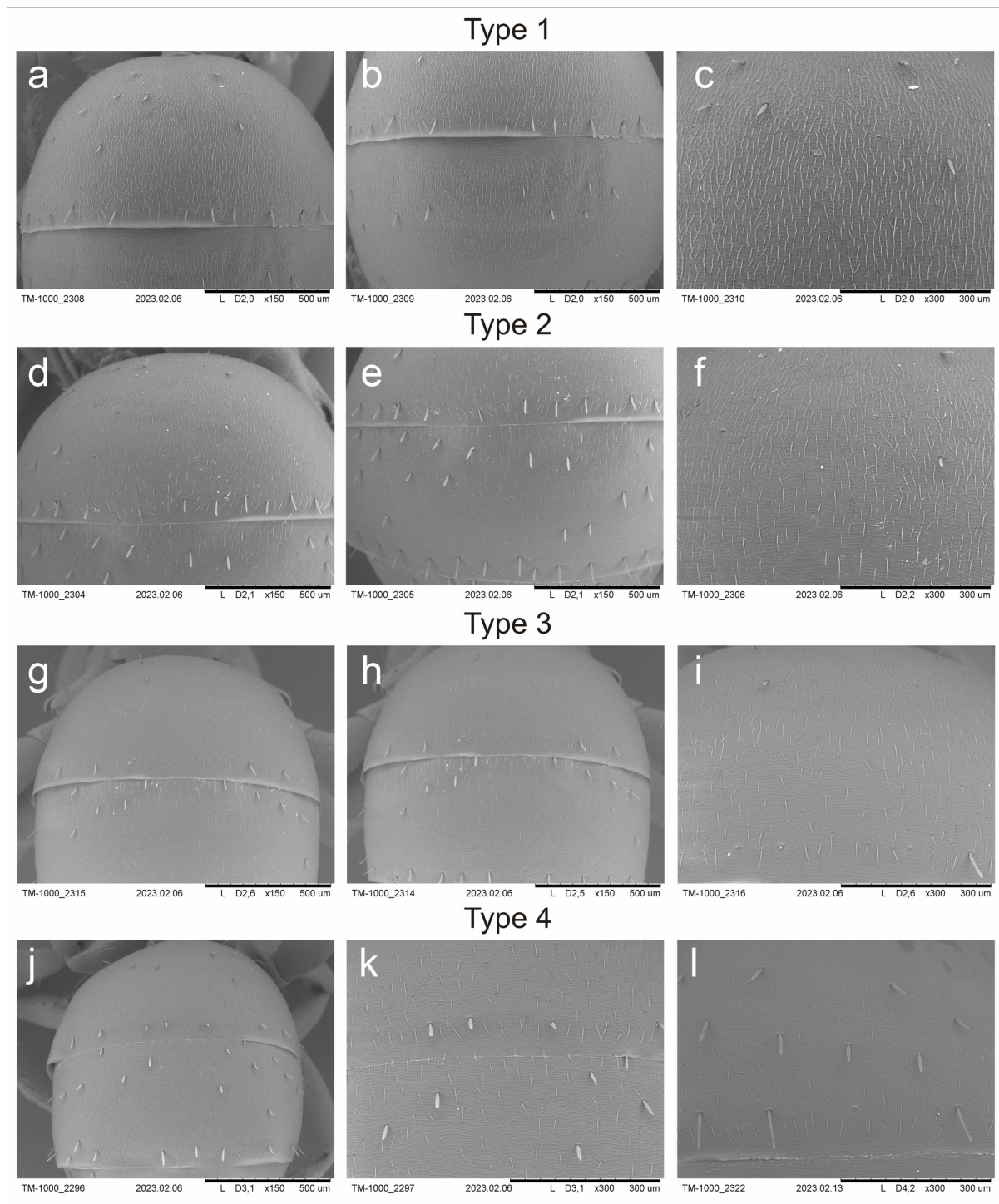




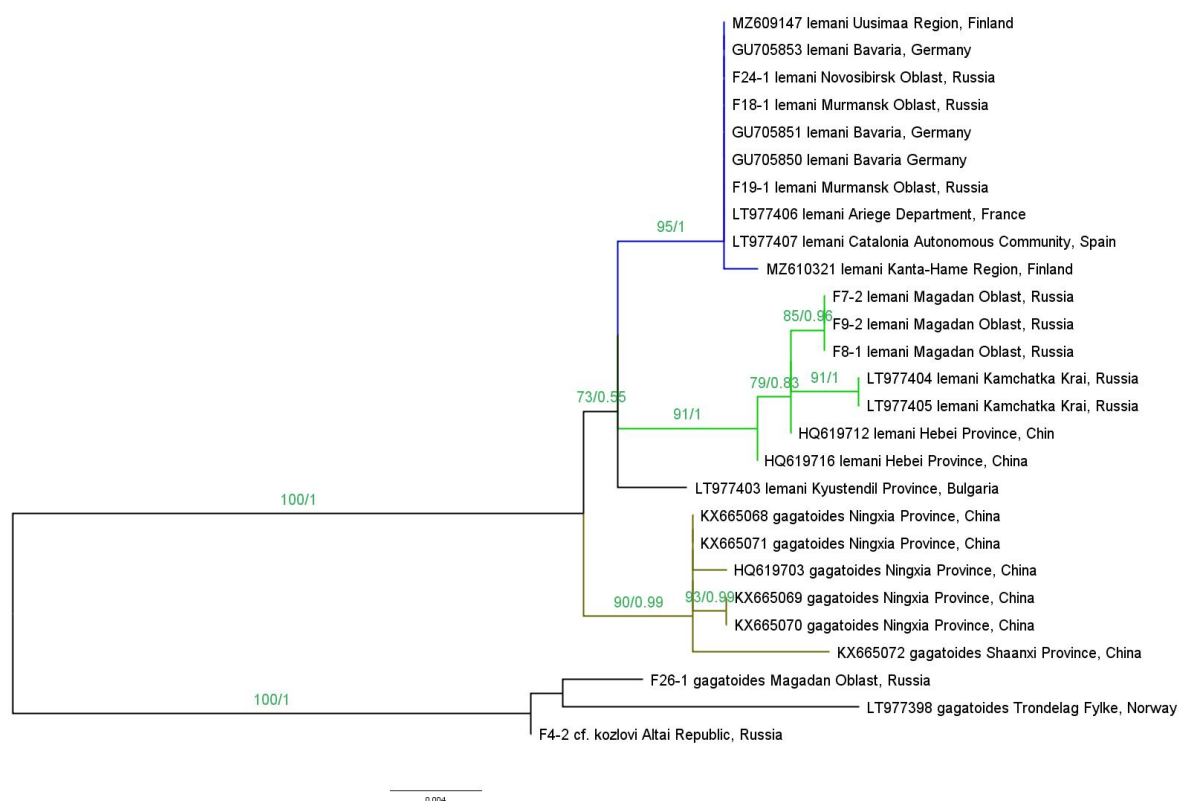
**Figure S1.** The main types of chaetotaxy (1-36) reflecting the number, size and arrangement of setae on the mid-leg femora of workers of the *F. gagatoides*/*F. cf. kozlovi* species complex collected in Altai.



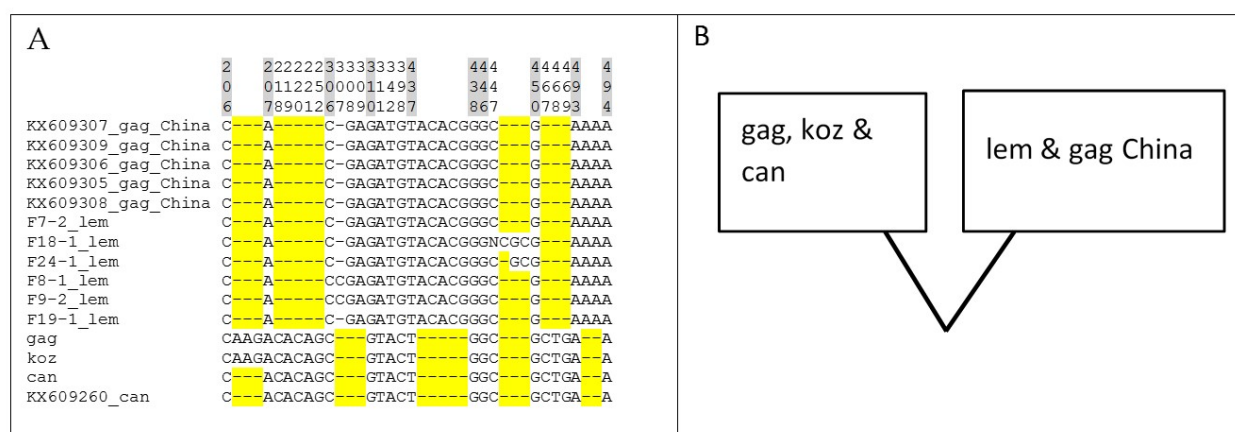
**Figure S2.** Morphological features of the pronotum of females *Formica gagatoides* and *F. kozlovi*. 1 - *F. gagatoides* (according to Dlussky [6]), 2 – *F. kozlovi* from the collection of the Zoological Museum of Moscow State University (the drawing is made according to the photo of the sample (Mongolia, Zaisan ad Ulan Bator, 1400 m a.s.l., 20.V.1962, leg. B. Pisarski et R. Bielawski, 3271, Inat. Zool.P.A.N. Warszawa, 65/62) kindly provided by E.B. Fedoseeva.



**Figure S3.** The main types of pubescence of gaster tergites I-III of the studied specimens of *F. gagatoides*/*F. cf. kozlovi* species complex (the photos were taken using Hitachi TM-1000 microscope). General view of pubescence hairs of gaster tergites I and II of specimens of *F. gagatoides*/*F. cf. kozlovi* complex: a, b, d, e, g, h, j (x150), k (x300). Central part of tergite I (x300): c, f, i – specimens of *F. gagatoides*/*F. cf. kozlovi* complex, l – *F. aff. candida*.



**Figure S4.** The maximum likelihood phylogenetic tree based on the standard region of COI sequences. The tree includes all COI sequences of *Formica lemni* obtained during the study and taken from the DNA database, «*F. gagatoides* from China», *F. gagatoides* – from Norway and Far East (Magadan Region Russia) and *F. cf. kozlovi* from Altai. The evaluations of branch support are shown (Bayesian posterior probabilities and the bootstrap values in percent at 1000 iterations). These evaluations are hidden if Bayesian posterior probabilities are less than 0.5 or the bootstrap values are less than 50 %. Branches of geographical populations of *F. lemni* and «*F. gagatoides* from China» are highlighted in color.

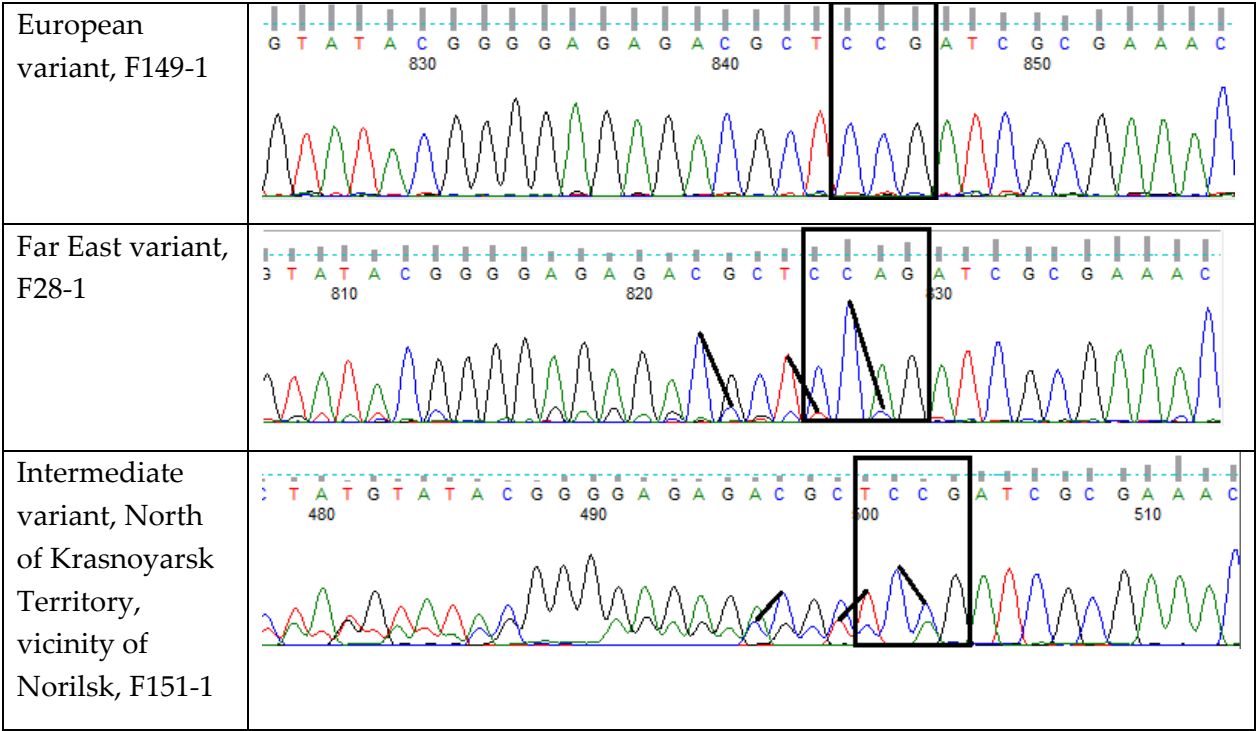


**Figure S5.** Variable positions in the first studied region of ITS1 (**A**) and simple phylogenetic scheme based on nucleotide substitutions in the studied DNA region (**B**). Groups: gag – *F. gagatoides*, koz – *F. kozlovi*, lem – *F. lemani*, can – *F. aff. candida*. Positions relative to *F. aff. candida* sequence (NCBI number KX609260, the lowest line) are shown as columns. Grey color indicates invariable positions that flanked deletions in the reference sequence. Yellow color shows entire deletions. Symbol N indicates heterozygosity by presence of additional «GC» in a microsatellite block. All the studied *F. gagatoides* (gag, 13 specimens), *F. cf. kozlovi* (4 specimens) and *F. aff. candida* (3 specimens) were identical within groups and formed the corresponding single lines. In the phylogenetic scheme, all the specimens in blocks are identical in the substitutions.

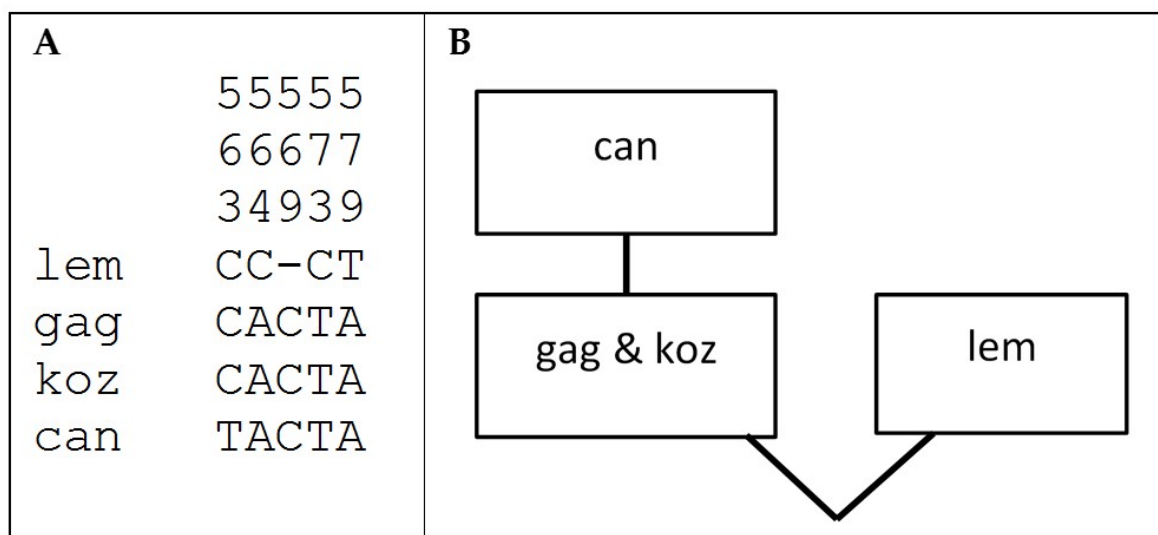


	7		8	8	8
	7		0	0	2
	3		4	5	3
F4-2koz	TATATACGTATATACATGCTATGTATACGGGGAGAGACGCTCC				GATCGCGAAACAACTT
F20-1FE	TATATACGTATATACATGCTATGTATACGGGGAGAGACGCTCC				GATCGCGAAACAACTT
F27-1FE	TATATACGTATATACATGCTATGTATACGGGGAGAGACGCTCC				GATCGCGAAACAACTT
F26-1FE	TATATACGTATATACATGCTATGTATACGGGGAGAGACGCTCC				GATCGCGAAACAACTT
F28-1FE	TATATACGTATATACATGCTATGTATACGGGGAGAGACGCTCC				GATCGCGAAACAACTT
F152-1Nor	TATATACGTATATACATGCTATGTATACGGGGAGAGACGCTCC				GATCGCGAAACAACTT
F148-1Murm	TATATACGTATATACATGCTATGTATACGGGGAGAGACGCTCC				GATCGCGAAACAACTT
F149-1Murm	TATATACGTATATACATGCTATGTATACGGGGAGAGACGCTCC				GATCGCGAAACAACTT
F151-1Nor	TATATACGTATATACATGCTATGTATACGGGGAGAGACGCTC				M-GATCGCGAAACAACTT
F150-1Nor	TATATACGTATATACATGCTATGTATACGGGGAGAGACGCTCC				GATCGCGAAACAACTT
F21-1FE	TATATACGTATATACATGCTATGTATACGGGGAGAGACGCTCC				GATCGCGAAACAACTT
F1-2FE	TATATACGTATATACATGCTATGTATACGGGGAGAGACGCTCC				GATCGCGAAACAACTT
F153-1Nor	TATATACGTATATACATGCTATGTATACGGGGAGAGACGCTCC				GATCGCGAAACAACTT
F156-1koz	TATATACGTATATACATGCTATGTATACGGGGAGAGACGCTC				M-GATCGCGAAACAACTT
F2-2koz	TATATACGTATATACATGCTATGTATACGGGGAGAGACGCTCC				GATCGCGAAACAACTT
	*****				*****
	8		9		9
	8		2		4
	4		0		3
F4-2koz	GGCTGATCGAAGGGCCAACGATTTTATCTCTCTCTCT				TCGGAGAGGAGACTAAGATGGAT
F20-1FE	GGCTGATCGAAGGGCCAACGATTTTATCTCTCTCTCT				TCGGAGAGGAGACTAAGATGGAT
F27-1FE	GGCTGATCGAAGGGCCAACGATTTTATCTCTCTCTCT				TCGGAGAGGAGACTAAGATGGAT
F26-1FE	GGCTGATCGAAGGGCCAACGATTTTATCTCTCTCTCT				TCGGAGAGGAGACTAAGATGGAT
F28-1FE	GGCTGATCGAAGGGCCAACGATTTTATCTCTCTCTCT				TCGGAGAGGAGACTAAGATGGAT
F152-1Nor	GGCTGATCGAAGGGCCAACGATTTTATCTCTCTCTCT				TCGGAGAGGAGACTAAGATGGAT
F148-1Murm	GGCTGATCGAAGGGCCAACGATTTTATCTCTCTCTCT				TCGGAGAGGAGACTAAGATGGAT
F149-1Murm	GGCTGATCGAAGGGCCAACGATTTTATCTCTCTCTCT				TCGGAGAGGAGACTAAGATGGAT
F151-1Nor	GGCTGATCGAAGGGCCAACGATTTTATCTCTCTCTCT				TCGGAGAGGAGACTAAGATGGAT
F150-1Nor	GGCTGATCGAAGGGCCAACGATTTTATCTCTCTCTCT				TCGGAGAGGAGACTAAGATGGAT
F21-1FE	GGCTGATCGAAGGGCCAACGATTTTATCTCTCTCTCT				TCGGAGAGGAGACTAAGATGGAT
F1-2FE	GGCTGATCGAAGGGCCAACGATTTTATCTCTCTCTCT				TCGGAGAGGAGACTAAGATGGAT
F153-1Nor	GGCTGATCGAAGGGCCAACGATTTTATCTCTCTCTCT				TCGGAGAGGAGACTAAGATGGAT
F156-1koz	GGCTGATCGAAGGGCCAACGATTTTATCTCTCTCTCT				TCGGAGAGGAGACTAAGATGGAT
F2-2FE	GGCTGATCGAAGGGCCAACGATTTTATCTCTCTCTCT				TCGGAGAGGAGACTAAGATGGAT
	*****				*****

**Figure S6.** Variabilities in two ClustalW alignment blocks of ITS1 of *F. gagatoides* and *F. cf. kozlovi*. Positions relative to *F. aff. candida* sequence (NCBI number KX609260) are shown as columns. Symbol «M» shows the superposition of A and C nucleotides. Suffix «koz» – *F. cf. kozlovi* specimens, «FE» – Far east, «Murm» – Murmansk Region, «Nor» – Norilsk vicinity.



**Figure S7.** Quantitative variability in the region of single in/del in ITS1 region of *F. gagatoides*. Lines show relations between peaks with different altitude.



**Figure S8.** Variable positions in the studied 28S rDNA region (A) and simple phylogenetic scheme based on nucleotide substitutions in the studied DNA region (B). Groups: gag – *F. gagatoides*, koz – *F. kozlovi*, lem – *F. lemani*, can – *F. aff. candida*. Positions relative to our *F. aff. candida* sequences are shown as columns. All our *F. gagatoides* with *F. gagatoides* from NCBI database (15 specimens), *F. cf. kozlovi* (4 specimens) and *F. aff. candida* (3 specimens) were identical within groups and formed the corresponding single lines. In the phylogenetic scheme, all the specimens in blocks are identical in the substitutions.