

New localities of protected lichen species on the Salair Ridge in Altai Territory

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New localities of eight lichen species included in the Red Data Book of the Altai Territory, *Lobaria pulmonaria*, *Ramalina roesleri*, *R. sinensis*, *Graphis scripta*, *Heterodermia speciosa*, *Nephroma bellum*, *Ramalina vogulica*, and *Usnea longissima* are reported for the Salair Ridge. The last five species recorded to the Salair Ridge within Altai Territory for the first time. Localities and ecological preferences are indicated for each species.

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Keywords

Biodiversity, lichenized fungus, Red Data Book, Salair National Park

Introduction

The Salair Ridge is a low-mountain area in the northwest of the Altai-Sayan mountain system with an area of 22,500 km² with average elevations of 400-600 m and the highest mountain – Mt. Kivda, 621 m a.s.l. (Lashchinskiy et al. 2007). Administratively, the territory of the Ridge is located at the border of Kemerovo, Novosibirsk Regions, and the Altai Territory. Lichen flora of the Salair Ridge

includes 673 species (Sedelnikova 2007), but only about one hundred of species were reported for the Salair botanical-geographical area ("Salair and Predsalairye" in Silantieva 2013) of the Altai Territory (Davydov 1999, 2004, 2014; Davydov and Konoreva 2017; Konoreva et al. 2016; Stas' 1999; Vondrák et al. 2016, 2019).

The new edition of the Red Data Book of the Altai Territory (Shmakov and Silantieva 2016) includes 23 species of lichens, and only 3 of them, namely *Lobaria pulmonaria* (L.) Hoffm., *Ramalina roesleri* (Schaer.) Hue and *Ramalina sinensis* Jatta were recorded from Salair Ridge (Davydov 2016). Recently we reported the data on the population density of protected lichens in forests with spruce, fir and Siberian pine, as well as linden forests on the Salair Ridge within Altai Territory (Davydov et al. 2020, 2021), but localities of the species remain without adequate documentation in the scientific literature. Here we amend this inaccuracy and discuss the occurrences of protected lichens on the Salair Range in detail.

Material and methods

Field observations were made in Eltsovsky, Togulsky and Zarinsky Districts of the Altai Territory during 2019–2021. Voucher specimens of every species of protected lichen were collected by authors and deposited in the herbarium of the Altai State University (ALTB). Morphological observations were made using a stereomicroscope Zeiss Stemi 2000-C. Cross-sections of apothecia and thalli were made by hand with a razor blade and observed with a Zeiss Axio Lab.A1 compound microscope after mounting in water. Lichen substances of some species were studied by spot-tests using potassium hydroxide solution (K), sodium hypochlorite solution (C), 1,4-p-phenyldiamine (PD), and iodine (I) (Orange et al. 2001).

Results

***Graphis scripta* (L.) Ach.**

Graphis scripta is common in forests dominated by *Tilia sibirica* and relatively rare in *Abies sibirica* forests and secondary (logged) stands. It grows on a smooth bark of *Abies sibirica* Ledeb., *Caragana arborescens* Lam., *Padus avium* Mill., *Sorbus sibirica* Nakai, and *Tilia sibirica* Bayer from 0.5 to 3 m above the ground.

New localities: Altai Territory, Togulsky District: 53°41.87'N, 85°59.63'E; 53°41.87'N, 85°59.82'E; 53°41.84'N, 85°59.81'E; 53°41.89'N, 85°59.92'E; 53°41.92'N, 85°59.69'E; 53°41.96'N, 85°59.72'E; 53°41.97'N, 85°59.82'E; 53°41.97'N, 85°59.91'E; 53°42.22'N, 85°59.91'E; 53°42.95'N, 85°59.87'E; 53°41.85'N, 86°00.63'E; 53°41.93'N, 85°59.96'E; 53°41.99'N, 85°59.97'E; 53°41.98'N, 86°00.13'E; 53°41.91'N, 85°59.58'E; 53°41.98'N, 85°59.59'E; 53°42.20'N, 85°59.81'E; 53°42.11'N, 85°59.82'E; 53°42.13'N, 85°59.74'E; 53°42.15'N, 85°59.65'E; 53°42.65'N, 85°59.64'E; 53°41.85'N, 85°59.70'E; 53°34.32'N, 86°07.45'E; 53°33.78'N, 86°08.58'E; 53°33.69'N, 86°08.68'E; Zarinsky District: 53°55.53'N, 85°53.26'E; 53°56.89'N, 85°52.88'E; 53°56.13'N, 85°52.98'E; 53°55.38'N, 85°53.30'E; 53°56.16'N, 85°53.21'E; 54°00.93'N, 85°54.60' E (Fig. 1).

***Heterodermia speciosa* (Wulfen) Trevis.**

A rare species was found in *Tilia sibirica* forests on *Tilia sibirica*. The maximum abundance is recorded in lichen communities with participation of *Lobaria pulmonaria*.

New localities: Altai Territory, Togul District: 53°41.84'N, 85°59.49'E; 53°41.85'N, 85°59.81'E; 53°41.97'N, 85°59.83'E; 53°41.9'N, 85°59.96'E; 53°42.00'N, 85°59.97'E; 53°41.86'N, 85°59.57'E; 53°41.91'N, 85°59.58'E; 53°41.98'N, 85°59.59'E; 53°41.85'N, 85°59.70' E (Fig. 2).

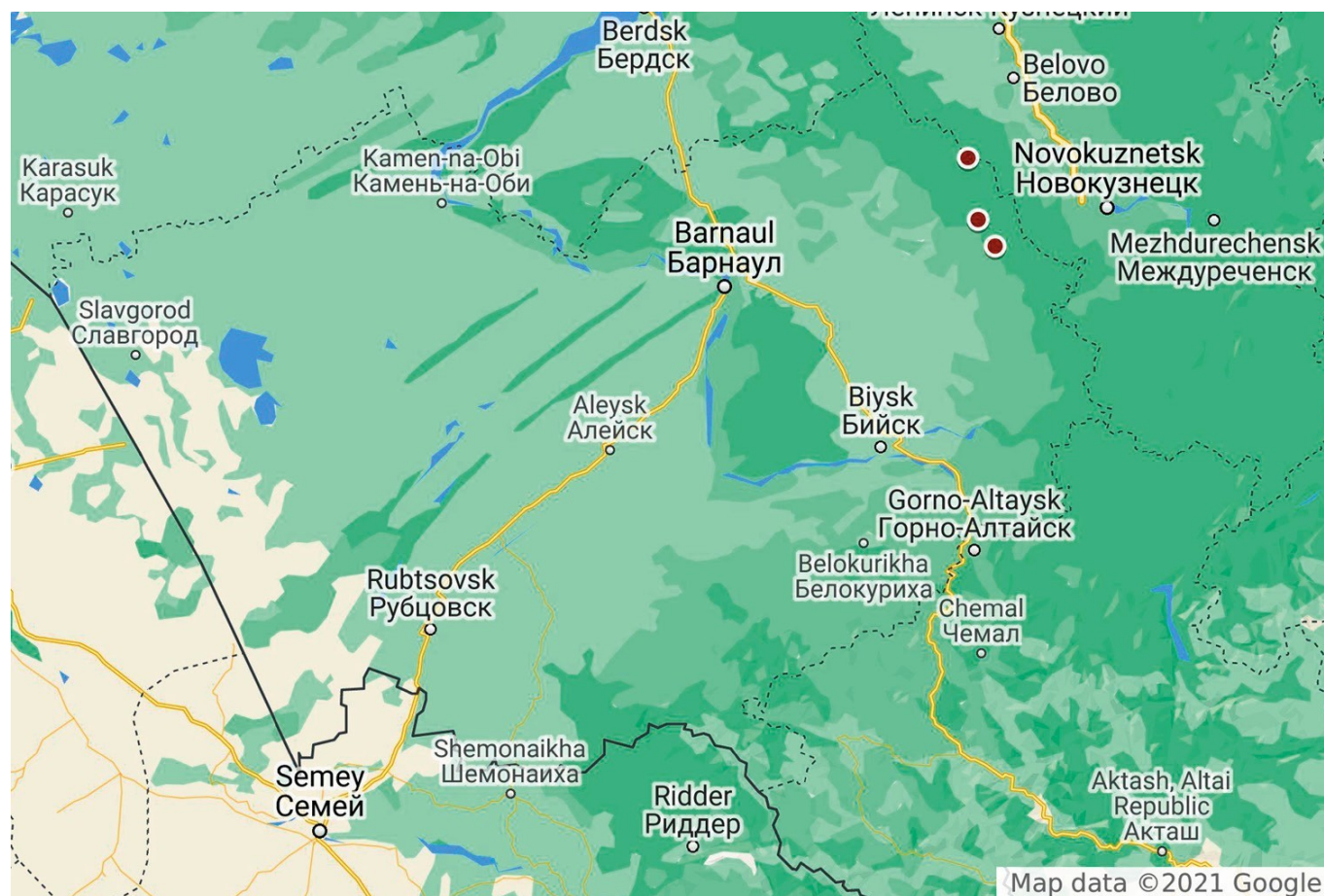


Figure 1. New localities of *Graphis scripta* in Altai Territory (red dots).

***Lobaria pulmonaria* (L.) Hoffm.**

A rare species that grows on *Salix* sp., *Sorbus sibirica*, *Tilia sibirica*, *Betula pendula*, and was once observed on rock outcrops. It is found in *Salix*-dominated valley forests, as well as in *Tilia sibirica* and *Abies sibirica* stands.

New localities: Altai Territory, Togul District: 53°41.97'N, 85°59.83'E; 53°42.22'N, 85°59.90'E; 53°41.98'N, 85°59.59'E; 53°55.46'N, 85°52.96'E; 53°55.99'N, 85°52.94'E; 53°55.64'N, 85°53.13'E; 53°55.86'N, 85°52.75'E; 53°56.55'N, 85°52.30'E; 53°56.70'N, 85°53.70'E; 53°55.82'N, 85°52.50'E; 53°55.34'N, 85°53.39'E; 53°55.53'N, 85°53.35'E; 53°55.89'N, 85°52.75'E. Zarinsky District: 53°57.48'N, 85°48.55'E (Fig. 3).

***Nephroma bellum* (Spreng.) Tuck.**

Nephroma bellum is a very rare species found in Salair only twice, on *Salix* sp. in an *Abies sibirica* forest and on *Tilia sibirica* in a *Tilia sibirica* forest together with *Lobaria pulmonaria*.

New localities: Altai Territory, Togul District: 53°41.97'N, 85°59.83'E. Zarinsky District: 53°57.48'N, 85°48.55' E (Fig. 4).

***Ramalina roesleri* (Schaer.) Hue**

Ramalina roesleri is common within the area, but having different abundance in various types of forests. It grows on bark and twigs of *Abies sibirica*, *Picea obovata*, *Sorbus sibirica*, *Tilia sibirica*, *Populus tremula*, *Salix* sp., and *Betula pubescens* at the altitude from 0.5 to 5 m above the ground.

The species is most abundant on dry twigs of *Abies sibirica*, *Tilia sibirica*, and *Picea obovata*.

New localities: Altai Territory, Eltsovsky District: 53°18.95'N, 86°47.87'E; 53°17.68'N, 86°27.74'E; 53°17.15'N, 86°27.54'E. Togulsky District: 53°41.84'N, 85°59.49'E; 53°41.87'N, 85°59.63'E; 53°41.87'N, 85°59.82'E; 53°41.85'N, 85°59.81'E; 53°41.89'N, 85°59.92'E; 53°41.92'N, 85°59.69'E; 53°41.96'N, 85°59.72'E; 53°41.97'N, 85°59.83'E; 53°41.97'N, 85°59.91'E; 53°42.22'N, 85°59.91'E; 53°42.55'N, 85°59.96'E; 53°42.95'N, 85°59.87'E; 53°41.85'N, 86°00.63'E; 53°41.93'N, 85°59.96'E; 53°41.99'N, 85°59.97'E; 53°41.98'N, 86°00.13'E; 53°41.86'N, 85°59.57'E; 53°41.90'N, 85°59.58'E; 53°41.98'N, 85°59.59'E; 53°42.20'N, 85°59.81'E; 53°42.11'N, 85°59.82'E; 53°42.13'N, 85°59.74'E; 53°42.15'N, 85°59.65'E; 53°42.65'N, 85°59.64'E; 53°41.85'N, 85°59.70'E; 53°38.54'N, 86°01.63'E; 53°38.51'N, 86°01.64'E; 53°36.88'N, 86°02.23'E; 53°34.32'N, 86°07.43'E; 53°34.55'N, 86°07.23'E; 53°33.69'N, 86°08.80'E. Zarinsky District: 53°55.47'N, 85°52.96'E; 53°56.00'N, 85°52.28'E; 53°56.25'N, 85°52.20'E; 53°55.48'N, 85°52.91'E; 53°56.95'N, 85°52.88'E; 53°56.11'N, 85°53.23'E; 53°55.95'N, 85°52.96'E; 53°55.38'N, 85°53.30'E; 53°55.72'N, 85°52.98'E; 53°55.50'N, 85°53.44'E; 54°01.52'N, 85°53.80'E; 54°00.93'N, 85°54.60'E; 53°55.10'N, 85°52.27'E; 53°55.48'N, 85°53.17'E; 53°55.47'N, 85°52.95' E (Fig. 5).

***Ramalina sinensis* Jatta (*Ramalina asahinana* Zahlbr.)**

Ramalina sinensis is a quite rare species scarcely distributed in Salair and occurring mostly in valley *Salix* forests, *Picea obovata* forests, as well as in *Abies sibirica* and *Tilia sibirica* dominated communities. The species grows on bark of *Populus tremula*, *Salix* sp., *Tilia sibirica*, *Abies sibirica*, and *Picea obovata* from 1 to 5 m above the ground.

New localities: Altai Territory, Eltsovsky District: 53°18.95'N, 86°47.87'E; Togulsky District: 53°41.92'N, 85°59.69'E; 53°41.96'N, 85°59.72'E; 53°41.97'N, 85°59.83'E; 53°42.22'N, 85°59.91'E; 53°41.98'N, 85°59.59'E; 53°42.20'N, 85°59.81'E; 53°42.11'N, 85°59.82'E; 53°42.13'N, 85°59.74'E; 53°42.15'N, 85°59.65'E; 53°36.84'N, 86°02.23'E; 53°34.66'N, 86°07.57'E; 53°34.31'N, 86°07.51'E; Zarinsky District: 53°55.73'N, 85°52.96'E; 53°55.53'N, 85°53.81'E; 53°55.92'N, 85°52.85'E; 54°01.52'N, 85°53.80'E; 54°00.93'N, 85°54.60'E; 53°55.10'N, 85°52.27'E; 53°55.48'N, 85°53.17'E; 53°55.47'N, 85°52.95' E (Fig. 6).

***Ramalina vogulica* Vainio**

Ramalina vogulica is a very rare species scarcely distributed in Salair. Single thalli occasionally found in *Abies sibirica*, *Picea obovata*, *Tilia sibirica*, and *Salix* sp. forests on bark of *Picea obovata*, *Tilia sibirica*, *Populus tremula*, *Salix* sp. and *Abies sibirica*.

New localities: Altai Territory, Togulsky District: 53°41.84'N, 85°59.49'E; 53°41.97'N, 85°59.83'E; 53°42.00'N, 85°59.97'E; 53°42.15'N, 85°59.65'E; 53°33.66'N, 86°08.68'E; Zarinsky District: 53°55.86'N, 85°52.24'E; 53°55.48'N, 85°53.17'E; 53°55.47'N, 85°52.95' E (Fig. 7).

***Usnea longissima* Ach.**

Usnea longissima is a rare species scarcely distributed in *Abies sibirica* and *Picea obovata* forests. The species grows on *Picea obovata*, *Abies sibirica*, and *Betula pubescens*.

New localities: Altai Territory, Zarinsky District: 53°55.48'N, 85°52.97'E; 53°56.66'N, 85°53.16'E; 53°56.11'N, 85°53.21'E; 53°55.27'N, 85°52.59'E; 53°55.85'N, 85°52.15'E; 53°55.85'N, 85°52.40'E; 53°55.87'N, 85°52.53'E; 53°55.87'N, 85°52.44'E; 53°56.70'N, 85°53.69'E; 53°56.36'N, 85°51.98'E; 53°55.47'N, 85°52.95' E (Fig. 8).

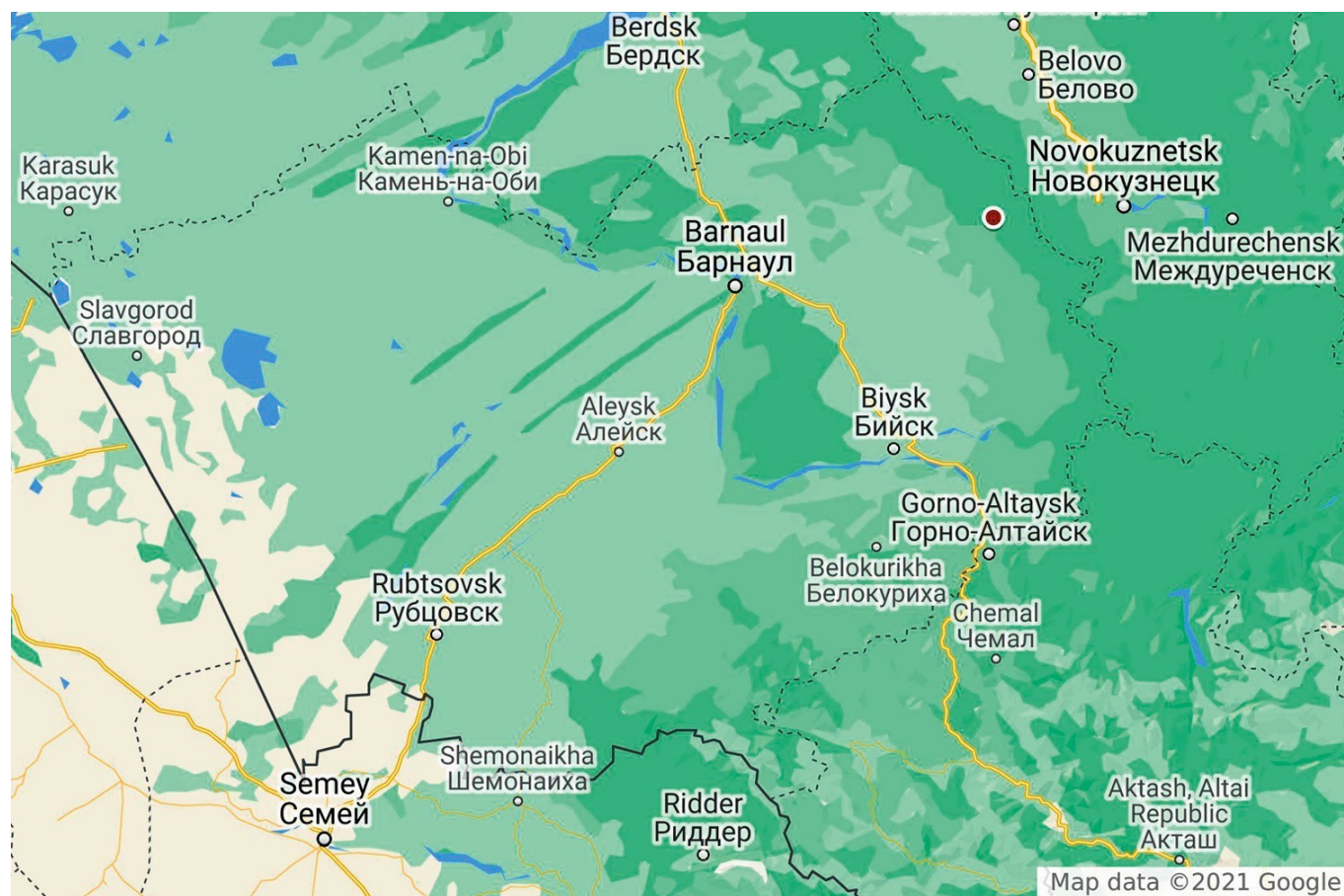


Figure 2. New localities of *Heterodermia speciosa* in Altai Territory (red dot).

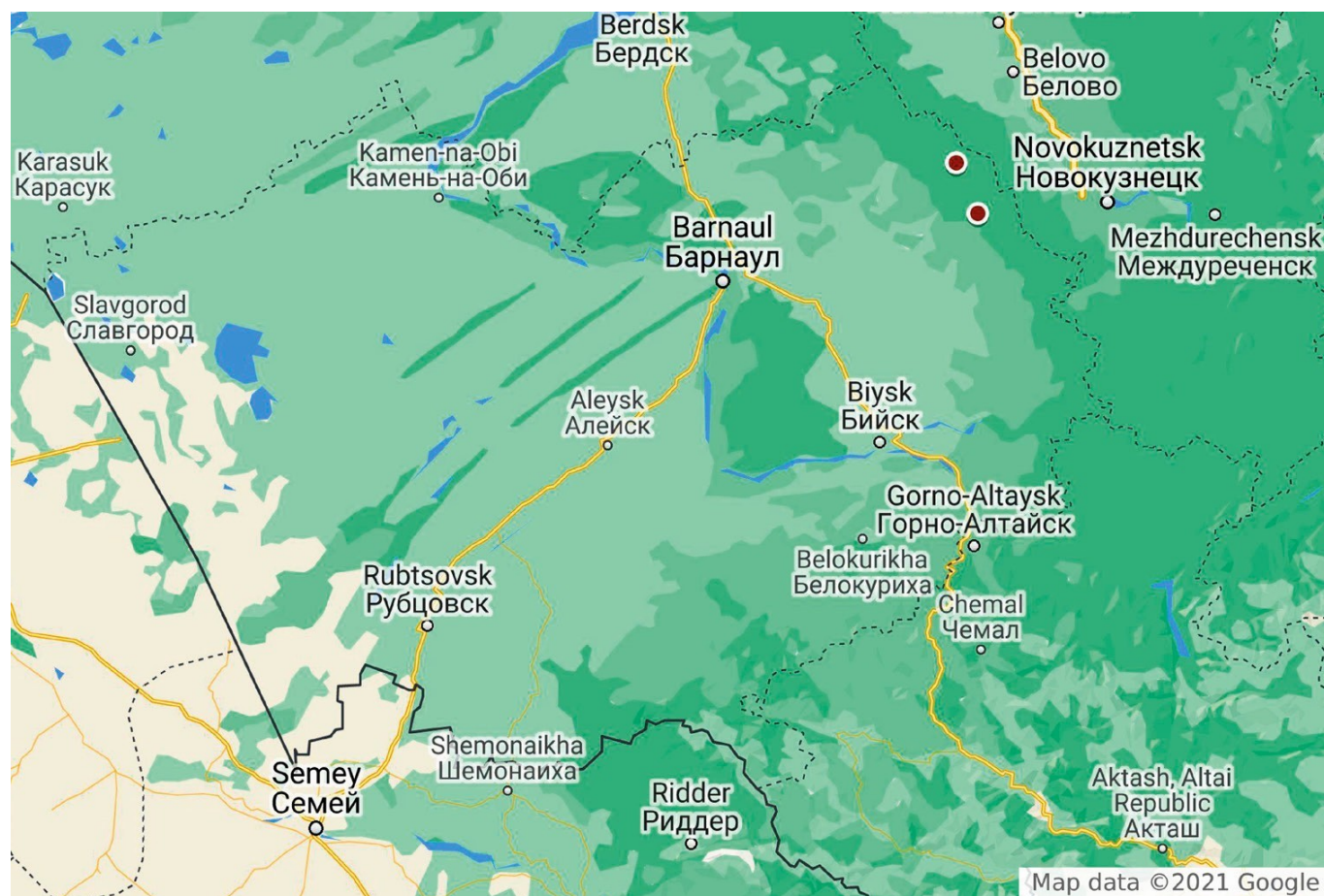


Figure 3. New localities of *Lobaria pulmonaria* in Altai Territory (red dots).

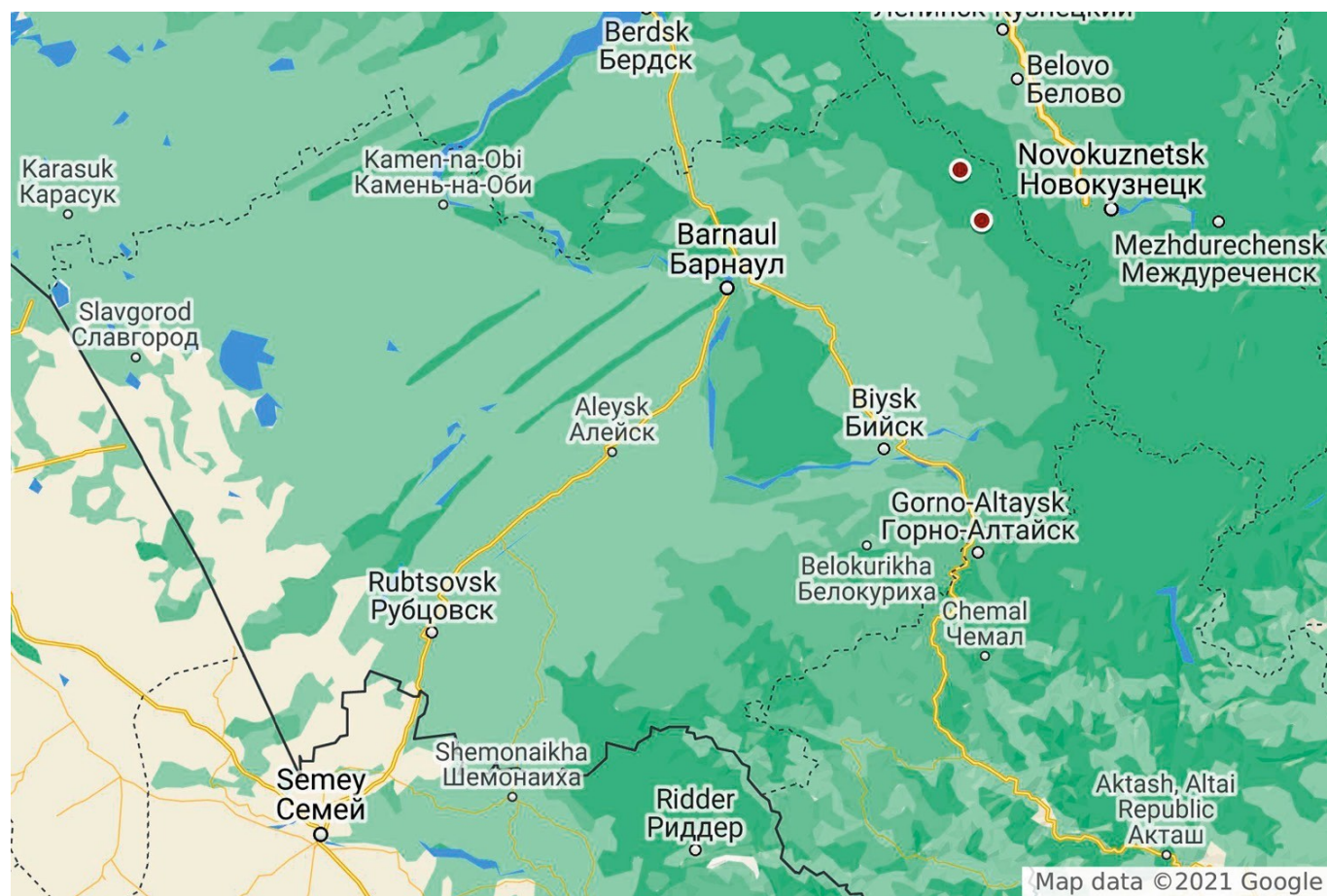


Figure 4. New localities of *Nephroma bellum* in Altai Territory (red dots).

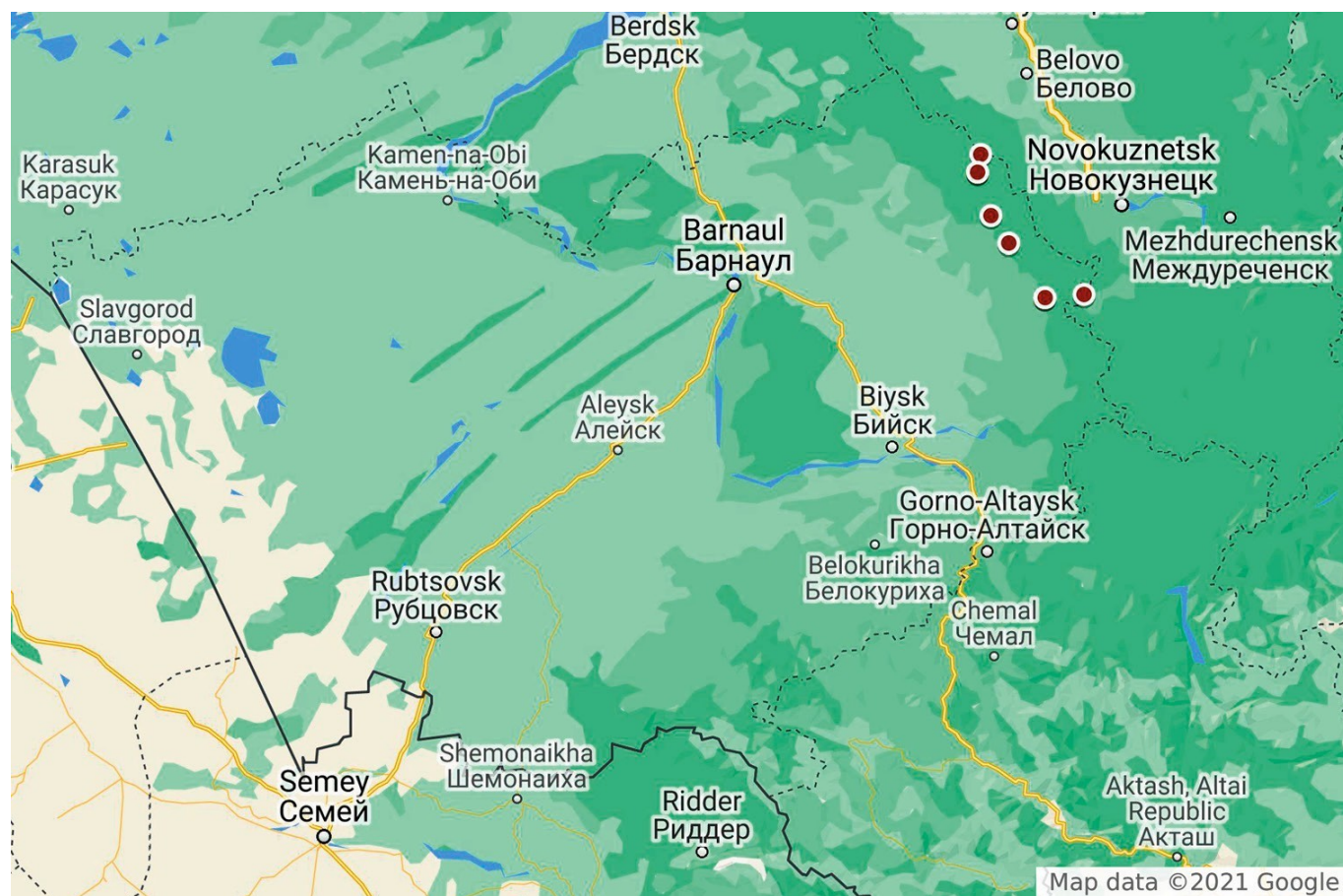


Figure 5. New localities of *Ramalina roesleri* in Altai Territory (red dots).

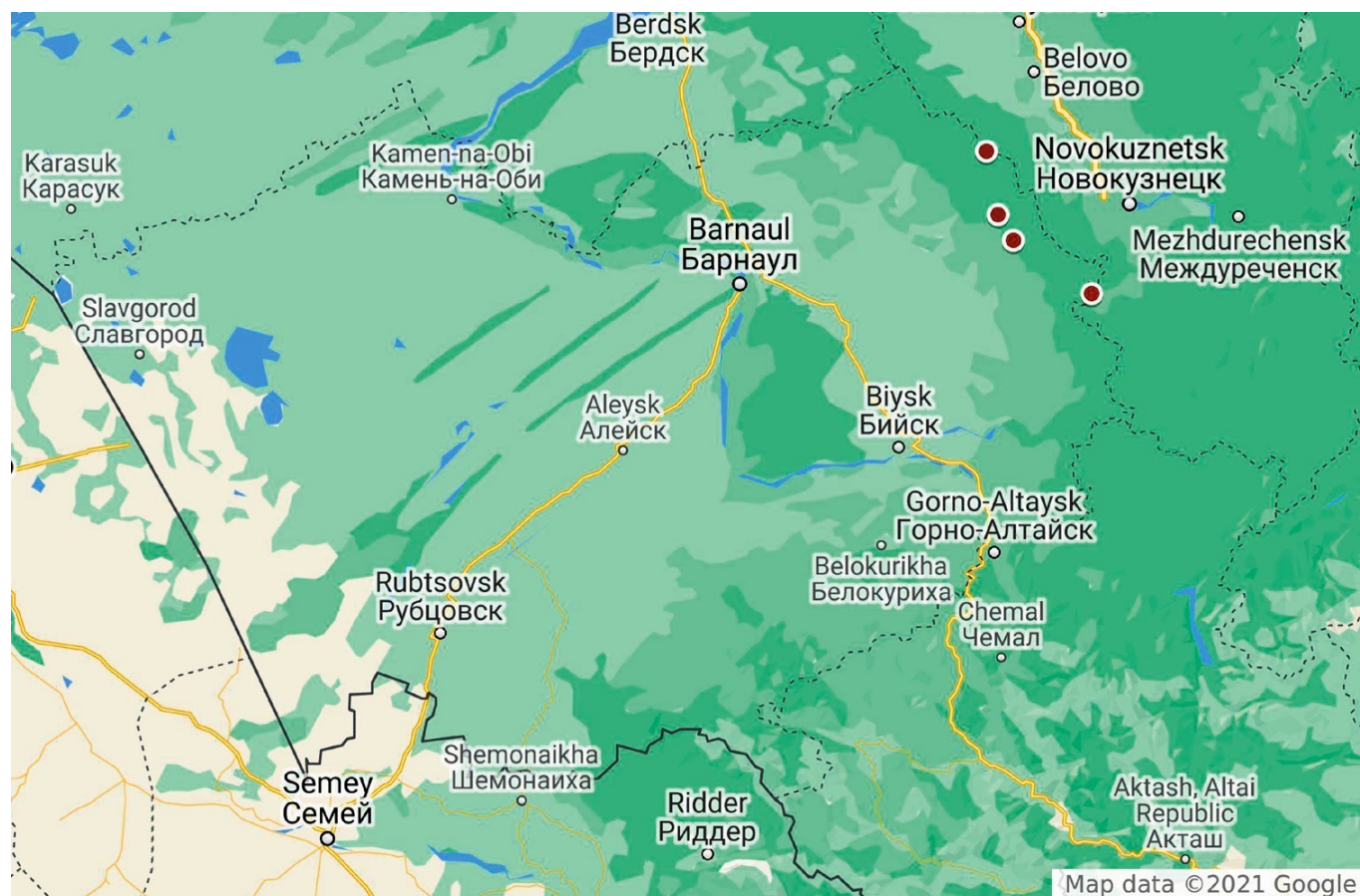


Figure 6. New localities of *Ramalina sinensis* in Altai Territory (red dots).

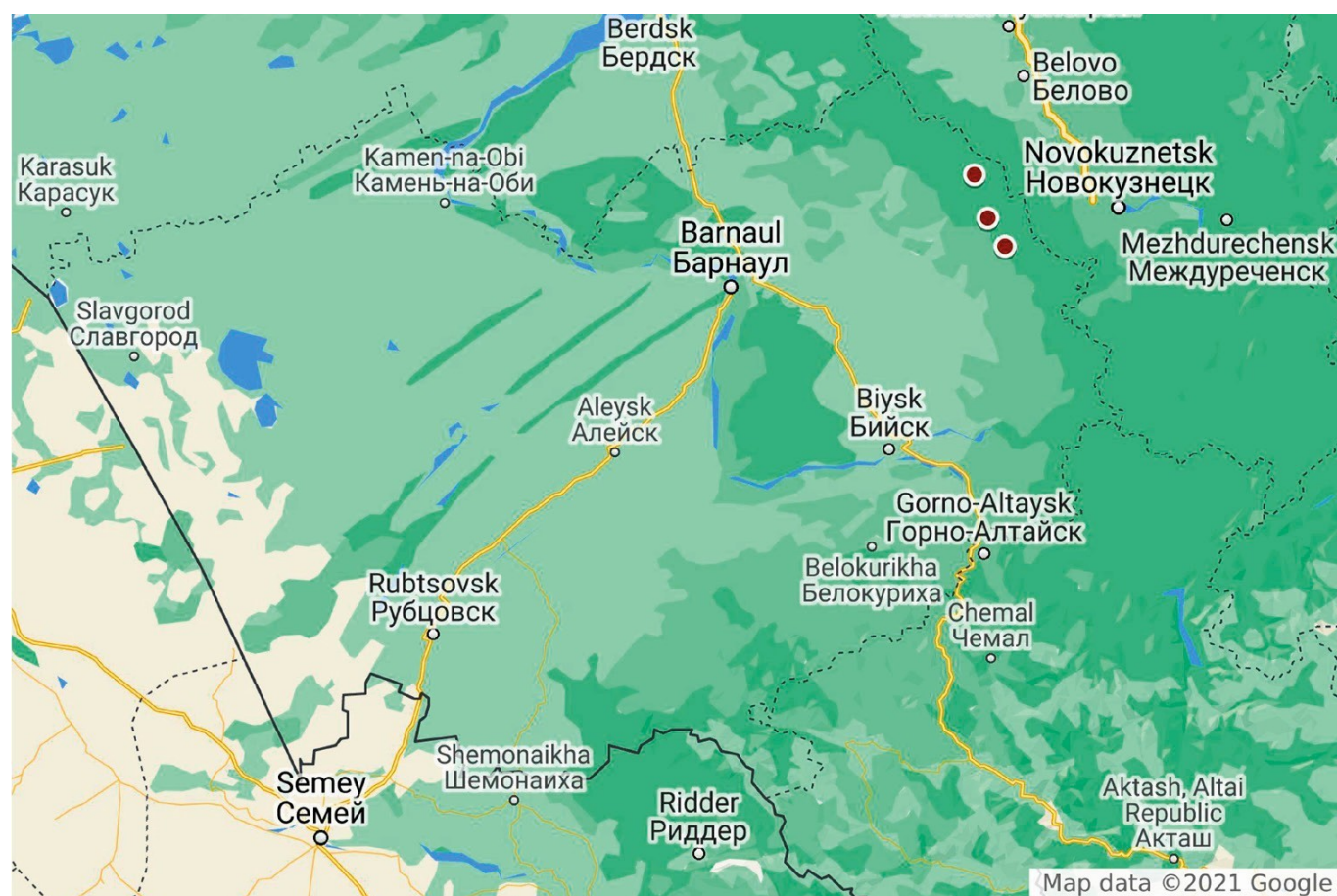


Figure 7. New localities of *Ramalina vogulica* in Altai Territory (red dots).

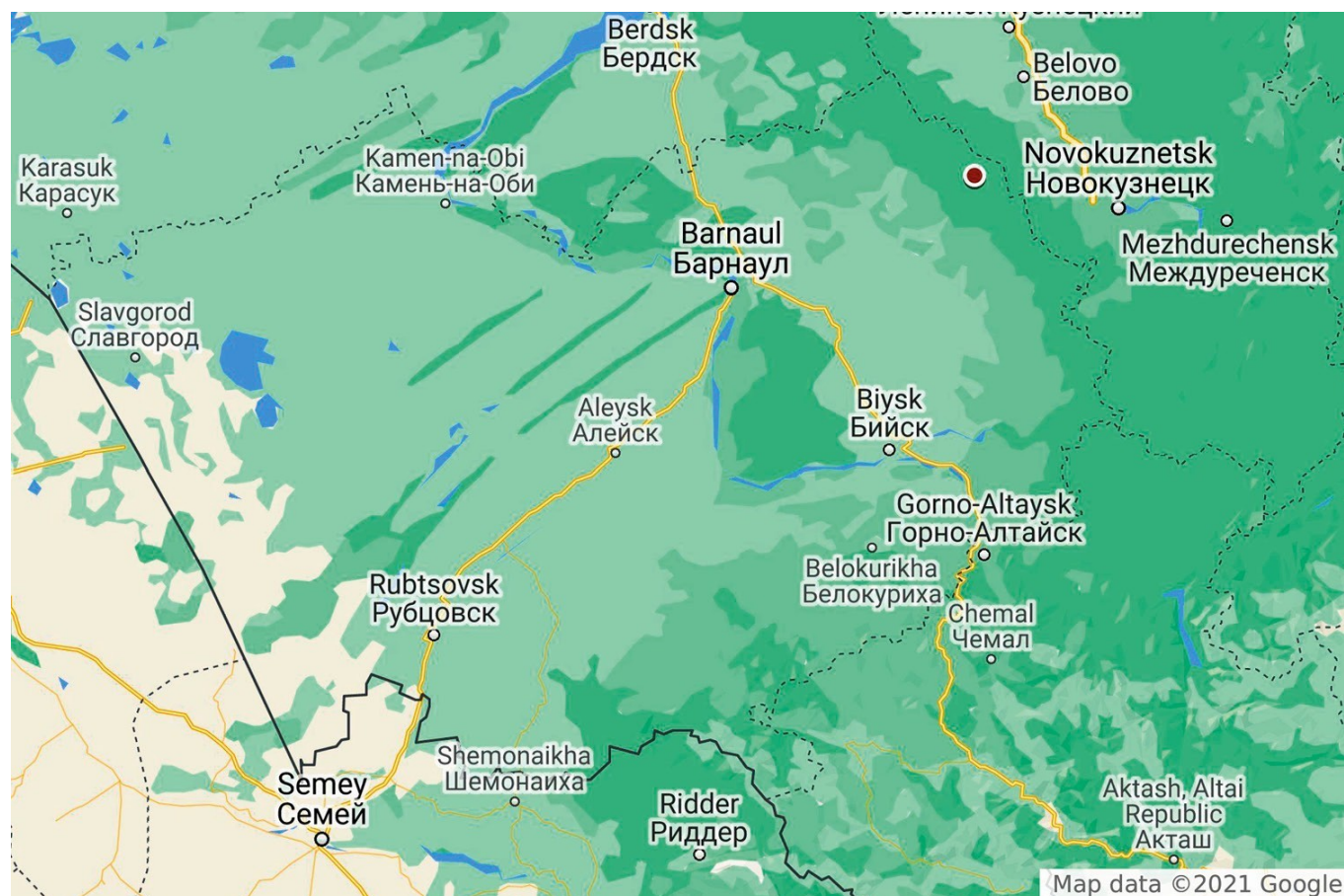


Figure 8. New localities of *Usnea longissima* in Altai Territory (red dots).

Discussion

All reported species were previously known in Altai Territory from North-West and North Altai.

Graphis scripta was previously recorded in North-West Altai where it grows on bark of *Abies sibirica* and *Sorbus sibirica* in *Abies sibirica* forests (Davydov 2001, 2011). In Salair Ridge *Graphis scripta* is a much more common and abundant species.

Heterodermia speciosa was recorded from the North-West Altai where it is most common on rock outcrops in mountain forests, but also inhabits bark of deciduous trees (Davydov 2001, 2008a, 2011).

Lobaria pulmonaria is locally common in the North-West Altai where it grows on *Salix* sp., *Betula* sp. and other deciduous and coniferous trees as well as on mossed rocks (Davydov 1999). In Salair Ridge *Lobaria pulmonaria* is a rare species. *Nephroma bellum* was found only in low-mountain *Abies sibirica* forests in the North-West Altai and it is relatively more common in the Altai Mountains compared with the Salair Ridge (Zavarzin and Davydov 2000; Davydov 2001, 2008a, 2011).

Ramalina roesleri is rare in the North-West Altai and recorded from few localities only (Davydov 2016), while it is the most common protected lichen in the Salair Ridge. In the earlier publications (Davydov 1995, 2001) the name *Ramalina roesleri* were erroneously applied to young thalli of *Ramalina dilacerata* (Hoffm.) Hoffm. (Davydov 2011).

Ramalina sinensis grows in the North-West and North Altai in valley *Salix* forests (Davydov 2010;

Davydov and Konoreva 2015). The umbilicate morphotype – *Ramalina asahinana* – was recorded in Altai Territory exclusively from Salair and Predsalairye (Stas' 1999).

Ramalina vogulica is a very rare both in Salair and the North-West Altai where it was recorded from two close localities in *Salix* valley forest within *Abies sibirica* subnemoral forest (Davydov 2004, 2005).

Usnea longissima is a very rare species in the North-West Altai where it is recorded from two close localities in *Abies sibirica* subnemoral forest (Davydov 2004, 2011).

All protected species of lichens of Altai Territory can be subdivided into two groups according to their ecology and distribution (Davydov 2008b). The majority of species grows in mountain forests of the West and North Altai Mountains and Salair in eastern part of the Altai Territory and five species occur in arid habitats in its south-western part. Eighteen species of 23 were recorded from the West and North Altai. As far as low-mountain area both in West and North Altai, and Salair Ridge are covered mostly by similar types of vegetation, i.e. *Abies sibirica* subnemoral forests and its derivatives, findings of remaining 10 species in Salair Ridge remains is highly likely.

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