Steppes of Southern Siberia

Experiences from the 6th EDGG Research Expedition to Khakassia, Russia (22 July – 1 August 2013)

Monika Janišová[1], Thomas Becker[2], Ute Becker[3], Olga Demina[4], Iwona Dembicz[5], Nikolai Ermakov[6], Goffredo Filibeck[7], Dieter Frank[8], Riccardo Guarino[9], Renaud Jaunatre[10], Łukasz Kozub[5], Mariya Polyakova[6], Kohei Suzuki[11], Jürgen Dengler[12, 13, 14]

1) Institute of Botany, Slovak Academy of Sciences, Ďumbierska 1, 97411 Banská Bystrica, SLOVAKIA; E-mail:monika.janisova@gmail.com

2) Geobotany, Faculty of Geography and Geosciences, University of Trier, Behringstr. 21, 54296 Trier, GERMANY; E- mail: beckerth@uni-trier.de

3) Green School in the Botanic Garden, University of Mainz, Anselm-Franz-von-Bentzel-Weg 9b, 55128 Mainz, GERMANY, E-mail: beckeru@uni-mainz.de

4) Institute of Biology, Botanical Garden, Southern federal university, Laboratory of Biodiversity, Stachki Str. 194/1, 344090 Rostov-on-Don, RUSSIA; E-mail: ondemina@yandex.ru

5) Department of Plant Ecology and Environmental Conservation, Faculty of Biology, University of Warsaw, Al. Ujazdowskie 4, 00-478 Warszawa, POLAND; E-mail: iwodem@op.pl (I. Dembicz), kozub.lukasz@gmail.com (Ł. Kozub)

6) Laboratory of Ecology and Geobotany, Central Siberian Botanical Garden, Russian Academy of Sciences, Siberian Branch, Zolotodolinskaya str. 101, 630090 Novosibirsk, RUSSIA; E-mail: brunnera@mail.ru (N. Ermakov), galatella@mail.ru (M. Polyakova)

7) Department of Agriculture, Forestry, Nature and Energy, University of Tuscia, 01100 Viterbo, ITALY; E-mail: filibeck@unitus.it

8) State Agency for Environmental Protection Saxony-Anhalt, Nature Conservation dpt., Reideburgerstrasse 47, 06116 Halle, GERMANY; E-mail: dieter.frank@lau.mlu.sachsen-anhalt.de

9) Dipartimento di Biologia Ambientale e Biodiversita, University of Palermo, via Archirafi, 38, 90123 Palermo, ITALY; E-mail: guarinotro@hotmail.com

10) Université d'Avignon et des Pays de Vaucluse, Institut Méditerranéen de Biodiversité et d'Ecologie (UMR CNRS/IRD 7263/237), IUT, Site Agroparc BP 61207, 84911, Avignon Cedex 9, FRANCE; E-mail: renaud.jaunatre@yahoo.fr

11) Graduate School of Life and Environmental Sciences, University of Tsukuba, Tennodai 1-1-1, Tsukuba, Ibaraki 305-8572, JAPAN; E-mail: kohei0808@gmail.com

12) Disturbance Ecology, Bayreuth Center of Ecology and Environmental Research (BayCEER), University of Bayreuth, Universitätsstr. 30, 95447 Bayreuth, GERMANY; E-mail: juergen.dengler@uni-bayreuth.de

13) Synthesis Centre (sDiv), German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, Deutscher Platz 5e, 04103 Leipzig, GERMANY

14) Biodiversity, Evolution and Ecology of Plants (BEE), Biocenter Klein Flottbek and Botanical Garden, University of Hamburg, Ohnhorststr. 18, 22609 Hamburg, GERMANY

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Abstract: *The 6th EDGG Research Expedition took place in summer 2013 in the Kuznetsky Alatau Mountains, part of the Altai-Sayanian mountain region (Republic of Khakassia, Russia). A group of 14 scientists from seven countries studied the variety of steppe vegetation in two regions of the "Khakassky" Reserve – Lake Itkul (Shira region) and Podzaploty (Ordzhenikidzevsky region). Standardised sampling procedures including nested-plot series and phytosociological relevés of 10-m² plots were used to sample steppes of European-Siberian (Festuco-Brometea) and Central Asian (Cleistogenetea squarrosae) types. All terricolous plants present in the plots were sampled, including perennial and annual vascular plants, bryophytes, and lichens. The data will be used for analyses of scale-dependent diversity patterns and species-area relationships, as well as for studying vegetation-environment relationships and performing phytosociological classification.*

Keywords: biodiversity; bryophyte; *Cleistogenetea squarrosae*; *Festuco-Brometea*; lichen; nested plot; vascular plant; vegetation classification; vegetation-plot database, steppe.

Introduction

Palaearctic dry grasslands and steppes are among the plant communities that host the highest small-scale vascular plant diversity worldwide (Wilson et al. 2012). This ecologically outstanding position of dry grasslands together with their high endangerment and their beauty has stimulated many biologists to choose them as their study objects. Such motivations were also the main drivers for the establishment of the European Dry Grassland Group (EDGG) in 2008 (Vrahnakis et al. 2013). Despite the extensive literature about dry grasslands in Europe, the documentation of biodiversity patterns is still fragmented since the many local studies hardly ever used consistent methodology, such as identical plot sizes. Accordingly, the explanation of why certain European dry grassland types are so extremely species rich is so far merely based on circumstantial evidence as large-scale analyses are missing (e.g. Merunková et al. 2012). Species-area relationships

(SARs) at plot scale might be an important tool to understand the scale dependence of diversity-environment relationships and to allow standardisation of diversity values recorded on different plot sizes (Dengler 2009a). While large-scale SARs have been well explored with state-of-the-art methods in recent years (Drakare et al. 2006, Guilhaumon et al. 2008, Triantis et al. 2012), similar analyses at plot scale are generally rare (Crawley & Harral 2001, Dolnik 2003, Dengler 2009a), and even rarer for grasslands (Chiarucci et al. 2006, 2012, Dengler & Boch 2008). Further, the knowledge about bryophyte and lichen diversity in dry grasslands is particularly incomplete albeit the comparison of diversity patterns of vascular plants, bryophytes and lichens with their contrasting ecology is particularly promising (Löbel et al. 2006).

All these points together prompted the EDGG already during the first year of its existence to conduct its first, then still very small research expedition to Transylvania (Dengler et al. 2009). This first expedition resulted in an initial publication in a Web of Science journal last year (Dengler et al. 2012a), with two more on the way, and contributed two world records in the maximum richness paper of Wilson et al. (2012). In the following years, the EDGG Research Expeditions became a core part of the working group identity, attended by an increasingly international group of participants, which stimulated – beyond the scientific value of the gathered data – discussions about methodological approaches, ecological theories and syntaxonomic concepts. The second to fifth expedition went to Central Podolia (Ukraine; Dengler et al. 2010), NW Bulgaria (Apostolova et al. 2011, Pedashenko et al. 2013), Sicily (Italy; Guarino et al. 2012) and NW Greece (Dengler & Demina 2012). Most recently, the 6th EDGG Research Expedition, from which we report here, was conducted for the first time in a location outside Europe. Our destination was the natural steppe of Southern Siberia, in order to allow comparison of their compositional and diversity patterns with those of the mostly man-made, semi-natural dry grasslands of Europe (Vrahnakis et al. 2013).

In total, 14 scientists from seven countries (Germany, France, Italy, Japan, Poland, Russia and Slovakia) participated in the one and a half weeks of field work. Several others unfortunately had to cancel their participation at short notice because for the first time we were not able to secure any financial support. The group combined experienced senior scientists, young postdocs and PhD students as well as both participants of previous expeditions (8) and newcomers (6). As usual, standardised sampling methods were used also during this EDGG expedition to allow many different analyses, which now – after accumulation of data from six expeditions (plus very similar datasets from Öland [Löbel 2002], Saaremaa [Dengler & Boch 2008] and NE Germany [Dengler et al. 2004]) – can be used for interesting large-scale comparisons and meta-analyses. The core part of the sampling are the so-called "biodiversity plots", which follow ideas of Dengler (2009b). Basically, they consist of nested sampled areas from 0.0001, 0.001, 0.01, 0.1, 1, 10 and 100 m², with the smaller ones always replicated twice within the big 100-m² plot. On each plot size, all vascular plants, bryophytes and lichens that are superficially present (shoot presence or any-part system: Williamson 2003, Dengler 2008) are recorded. Additionally for the 10-m² plots, percentage cover per species and structural data of the vegetation are estimated and a set of environmental parameters related to topography and soil determined. In each individual study region, the biodiversity plots are placed in homogenous stands of different types with the aim to cover the full gradient of locally present grassland types. To complement this time-consuming sampling, we additionally survey "normal" plots, which have exactly the same parameters as the 10-m² corners of the biodiversity plots and can thus easily be combined with these for joint analyses.

This contribution starts with an introduction to the study area, followed by some preliminary results, conclusions and an outlook. After the reference section, an appendix with an illustrated diary follows.

Relief map of Khakassia with red circles showing the location of the two study areas. Source: http://commons.wikimedia.org/. Modified by the authors.

Study area

Our study area was the northern part of the Republic of Khakassia, which is one of 83 federal subjects of the Russian Federation. It is located in southern Siberia between 51° N and 55° N and 88° E and 91° E, near Mongolia (in 450 km distance), China (600 km) and Kazakhstan (550 km). The republic covers 61,900 km² and is inhabited by slightly more than half a million of inhabitants, resulting in a low population density of only 9 persons per km². In rural regions, the population is

Tatiana Oshepkova: Steppes of Khakassia. Source of the paintings: http://www.oshepkova.ru/kupit_kartini_pdrodaja_peyzaji_khakassia_oshepkova_galereya_all.html (with kind approval from the author)

even less dense because 165,000 people are concentrated in the capital Abakan, which can be reached by daily plane connections from Moscow (approx. 3,300 km).

The climate of Khakassia is ultracontinental with cold winters and hot summers, determined by its geographical position and specific conditions of a relief (Nikolskaya 1968). In the steppe zone, the average temperature in January varies from –19º C to –21º C, in July it is about +20º C. Mean annual precipitation is only 250–350 mm, of which 80% falls during summer. In winter, the snow cover is unevenly distributed, reaching a maximal depth of 10–20 cm. Due to the activity of wind, snow can be removed from open areas and hilltops leading to exposed soil surface and thus contributing to its deep freezing. During summer, the wind causes rapid evaporation of moisture from the unsheltered surfaces leading to extreme desiccation.

Khakassia is located in the zone of the Altai-Sayan folded Paleozoic structures, distinguished by a complex geological structure and variety of relief. Two main types of tectonic structures can be distinguished in Khakassia, Minusinskaya Basin and the adjacent systems of the Western Sayan and Kuznetsky Alatau (Nikolskaya 1968).

Most of our studies were carried out in two of the ten discontinuous segments of the State Natural Reserve "Khakassky zapovednik", which is a strict reserve (the highest category in the Russian system), namely segment Ozero Itkul (55.47 km²) and segment Podzaploty (51.81 km²) and their surroundings. These segments are located at approx. 54º N latitude, 90º E longitude and range from 400 to 700 m a.s.l. Both areas are placed on Devonian bedrock; Ozero (Lake) Itkul mainly on limestone and Podzaploty on sandstone. Rock layers are gently tiled in monoclines, and their variable resistance to erosion led to creation of cuestas. Around Lake Itkul, the steep rocky slopes are facing to south-west while in Podzaploty to north-east. Valley bottoms and lower parts of the slopes are covered with diluvial deposits, often sandy. In Podzaploty, the sedimentary rocks of the valley bottom are cut by dikes of Triassic and Upper Paleozoic basalts forming cone-shaped hills.

Steppes of the Minusinskaya Basin

Steppe is a zonal type of vegetation in Khakassia (Kuminova et al. 1976). Steppic landscapes are located on different landforms and bedrocks. A complex combination of ecological factors (different amounts of insolation and moisture, different degree of soil development) is a reason for the high variety of steppe types present in the same landscape, from dry steppes on the flat shallow-soil places and south-facing slopes to meadow steppes on flat deep-soil places and north-facing slopes.

In the Enesei basin eastern of the Kuznecky Alatau, a group of "islands" with steppe vegetation is located at

Tatiana Oshepkova: Lake in the steppe. Source of the paintings: http://www.oshepkova.ru/kupit_kartini_pdrodaja_peyzaji_khakassia_oshepkova_galereya_all.html (with kind approval from the author)

altitudes from 250 to 450 m a.s.l. In these so-called island steppes, the occurrence of *Stipa* species is significantly reduced and the role of Siberian-Mongolian plants is emphasized. For the southern Enesei steppes of the Minusinsk and Abakan regions, the so called "four-grass-steppe" is typical dominated by *Stipa krylovii*, *Cleistogenes squarrosa*, *Festuca* spec. div. and *Koeleria* spec. div. (Kholboeva & Namzalov 2011). The steppes in the montaneous regions differ from lowland steppes. They are frequently called the orographic steppes as their floristic composition strongly reflects the effects of slope aspect (Karamysheva 1993).

Tatiana Oshepkova: Summer. Source of the paintings: http://www.oshepkova.ru/kupit_kartini_pdrodaja_peyzaji_khakassia_oshepkova_galereya_all.html (with kind approval from the author)

The petrophytic steppes with alpine species are an unique element of the steppe vegetation in Khakassia. They occur on the top parts of hills and slopes of southern and southeastern exposition. In Khakassia, these species survive at lower altitudes (300–500 m a.s.l.) and occur on dry stony slopes with little snow in winter. In summer, these habitats are dry due to high insolation and well-drained soils. One peculiarity of these communities is a group of species otherwise occurring in the alpine zone (*Androsace dasyphylla*, *Dryas oxyodonta*, *Kobresia filifolia*, *Minuartia verna*, *Patrinia sibirica*, *Poa attenuata*, *Potentilla nivea*, *Sagina saginoides*).

Nature conservation

The different types of steppe communities are also habitats of rare plants, listed in the Red Books of various levels – *Adenophora rupestris*, *Astragalus ionae*, *Carex humilis*, *Lilium pumilum*, *Oxytropis includens*, *O. chakassiensis*, *Phlox sibirica*, *Stipa pennata*, *S. zalesski*. Three of these are endemic – *Adenophora rupestris*, *Oxytropis includens* and *O. chakassiensis*.

Steppes in Khakassia have been intensively used for agriculture; most frequently they were transformed to crop fields. Steppe areas unsuitable for crop cultivation were often exposed to significant grazing pressure. Several patches of natural steppes are preserved in nature reserves and remote areas.

Plant determination during the expedition

In addition to the good floristic knowledge of the Siberian participants based on the Flora of Siberia (1987–2003), we mainly relied on the Opredelitel rastenij Krasnojarskogo kraja (Krasnoborov 1979, in Russian) for vascular plant determination. Luckily for those team members who did not understand Russian, we could use a nice photo-flora of Mongolia (Hauck & Solongo 2010), the neighbouring country, with numerous common taxa in good photos and short English text, as well as the English translation of the Mongolian plant determination key (Grubov 2001). Moreover, there is also a relatively recent checklist for vascular plant flora of the former Soviet Union (Cherepanov 1995), whose nomenclature we use in this contribution.

First results

We surveyed 39 biodiversity plots and 55 additional normal plots, resulting in a total of 133 full relevés with soil samples (in comparison, 226 relevés were sampled during the expedition to Ukraine and 98 relevés during the expedition to Bulgaria). Based on the 22 biodiversity plots that have so far been entered into an electronic spreadsheet, we can present the preliminary data on diversity of the studied steppes. The mean richness values on the various spatial scales (Table 1) were clearly lower than in Transylvanian (Dengler et al. 2012), but higher than in Bulgarian *Festuco-Brometea* communities (Pedashenko et al. 2013).

Among the vascular plants, the most frequent graminoids were, in decreasing order, *Carex humilis*, *Festuca pseudovina*, *Carex pediformis*, *Stipa krylovii*, *Elytrigia lolioides* and *Koeleria cristata*. The most common forbs were *Thalictrum foetidum*, *Thymus serpyllum*, *Schizonepeta multifida*, *Iris ruthenica*, *Aster alpinus*, *Bupleurum scorzonerifolium*, *Leontopodium ochroleucum*, *Galium verum* and *Hedysarum gmelinii*. Surprisingly, among the matrix species there were not only Central Asian and arctic-alpine floristic elements, but also some species common in European grasslands.

Area [m²]	Mean	Min	Max
0.0001	2.4	0	5
0.001	4.7	1	9
0.01	9.6	3	16
0.1	19.1	10	31
1	33.0	18	54
10	49.2	33	75
100	70.9	48	99

Table 1: Mean plant species richness (shoot presence of vascular plants, bryophytes, lichens and "macroalgae") in 22 biodiversity plots in the Khakassian steppes (n = 44 for plots 0.0001–10 m²; n = 22 for 100-m² plots; preliminary data).

Bryophytes and lichens played an unusually minor role compared to common European dry grassland types (e.g. Dengler 2005, Boch & Dengler 2006, Löbel & Dengler 2008), both in terms of cover and richness. On average, there were four cryptogam species per 10 m². While pleurocarpous mosses and larger fruticose lichens were almost absent, the most frequent cryptogam synusia was the so-called coloured lichen community with species

from the genera *Toninia*, *Psora* and *Fulgensia*, which occurred mainly in the open, petrophytic types.

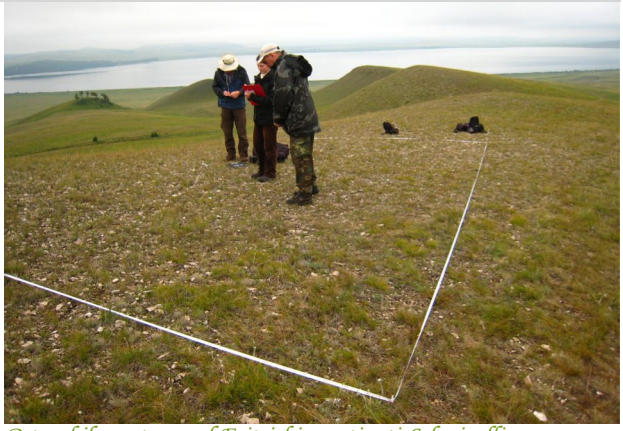
Comparison of the Khakassian and Mongolian steppes

Khakassian steppes have similarities in physiognomy and species composition both with European-Siberian and Mongolian (Central Asian) steppes. A recent overview of all syntaxa of Russia, including the Khakassian steppes, has been compiled by our local organiser (Ermakov 2012).

According to one of the participants, Kohei Suzuki, who has been studying the steppes of Mongolia for several years, the Khakassian steppes have similar species composition and physiognomy to Mongolian steppes. As a matter of fact, most of the Mongolian steppes are also classified to *Cleistogenetea squarrosae* Mirkin et al. ex Korotkov et al. 1991. First, the petrophytic vegetation in Khakassia (upper picture right) represented by *Eritrichio pectinati-Selaginellion sanguinolentae* Ermakov et al. 2006 is a vicarious alliance to *Thymion gobici* (Mirkin et al.) Mirkin in Kašapov et al. ex Hilbig (Hilbig 2000) in Mongolia (picture right). The occurrence of *Alyssum obovatum*, *Orostachys spinosa*, *Arctogeron gramineum*, *Arenaria capillaris*, *Ephedra monosperma* is common in both countries. Second, meadow steppe vegetation of the *Festuco valesiacae-Caricion pediformis* Ermakov et al. 2012 occurring on well-developed soil in Khakassia (picture right) resembles the vegetation of *Helictotrichion schelliani* Hilbig 2000 (Hilbig 2000) in Mongolia (lower picture right). Species such as *Aster alpinus*, *Dianthus versicolor*, *Galium verum*, *Gentiana decumbens*, *Leontopodium ochroleucum* and *Schizonepeta multifida* are typical for these communities. From the phytosociological point of view it is very interesting how species composition changes in similar vegetation types from Mongolia to Khakassia, and what is the main driving force for these changes.

Conclusions and outlook

Our plan is to have the data ready for analysis in the next few months. This is the first EDGG Research Expedition where we determined all sampled vascular plants already during the expedition. Moreover, a significant proportion of the field data are already digitised. So the remaining tasks before the analyses can start are determination of the sampled bryophytes and lichens, analysis of soil samples (these tasks are taken care of by the Russian colleagues) and the completion of the data entry into the database (will be done by some of the foreign participants). We are therefore optimistic that we could start our analyses already in winter 2013/14 and then would be able to submit a first paper in the following spring. Presently, we are searching possibilities for funding for an internship of the young Russian postdoc Mariya Polyakova in the lab of one of the senior European expedition participants in order to continue the experience exchange beyond the fieldtrip into the analytical and paper-writing stage. It will be interesting to compare the biodiversity patterns and species-area relationships with those of the previous EDGG Expeditions (Dengler et al. 2012a, Pedashenko et al. 2013, and unpublished data) and similar datasets. From the phytosociological point of view it is a challenging



Petrophilous steppe of Eritrichio pectinati-Selaginellion sanguinolentae in Khakassia. Photo: G. Filibeck

Petrophilous steppe of Thymion gobici in Mongolia. Photo: K. Suzuki

Steppe vegetation of Festuco valesiacea-Caricion pediformis on well-developed soil in Khakassia. Photo: G. Filibeck

Vegetation of Helictotrichion schelliani in Mongolia. Photo: K. Suzuki

Petrophilous steppe dominated by Carex humilis and Leontopodium ochroleucum near Itkul Lake. Photo: D. Frank

Colorful rocky grasslands on the mountain ridge above our camp in Podzaploty. Photo: D. Frank

Plant determination and entering the data during the evenings and nights. Photo: D. Frank and R. Jaunatre

question where to separate the Eurasian class of *Festuco-Brometea* Br.-Bl. et Tüxen ex Soó 1947 and of *Cleistogenetea squarrosae* Mirkin et al. ex Korotkov et al. 1991 (Korotkov et al. 1991, Hilbig 1995, Ermakov et al. 2006, Ermakov 2012), or whether these two classes are sensible at all, given the same ecology and physiognomy and the high overlap in dominant species (see above).

As in the case of the previous EDGG Research Expeditions, the sampled data will finally become part of the Database Species-Area Relationships in Palaearctic Grasslands (Dengler et al. 2012b; GIVD ID EU-00-003) and additionally of the Vegetation Database of North Asia (GIVD ID AS-00-002), both registered in the Global Index of Vegetation-Plot Databases (GIVD; http://www.givd.info; see Dengler et al. 2011). After our initial publication, these data can also be used by other researchers. Moreover, we plan to contribute the data to the emerging global vegetation-plot database sPlot (see http://www.idiv-biodiversity.de/sdiv/workshops/past-workshops/splot).

After five EDGG Research Expeditions in Eastern and Southern Europe, this was the first one to be conducted in Central Asia, and in fact the very first EDGG event outside Europe. While there have been a few non-European participants during previous EDGG Expeditions and European Dry Grassland Meetings, this was the one event with the highest fraction of North Asian colleagues. It is fantastic to see how the EDGG is coming, step by step, to represent the dry grassland and steppe researchers in the whole Palaearctic as stated in our Bylaws. Similarly, we recently had the first Central Asian paper in one of the EDGG Special Issues (Niu et al. in press).

Inspired by six successful research expeditions, the EDGG will certainly continue its expedition programme. For summer 2014 (likely end of June), we have already fixed the venue: it will be a transect in Northern Spain, from the semiarid Mediterranean plains to the alpine grasslands of the Pyrenees. This EDGG event in the western part of Europe will hopefully broaden our viewpoints and enrich our personal collaborations (details will be announced in the next Bulletin or via the EDGG mailing list). For the years from 2015 onwards no venues have been decided upon, but several options are in the discussion, among them Southern Norway, Gotland (Sweden), Poland, France, dry valleys of the Inner Alps, the Italian Alps around Lago di Garda, Albania/Montenegro/Macedonia, Crimea (Ukraine), Caucasus (Russian part), Anatolia (Turkey), Northern Iran, Kazakhstan or Mongolia. Criteria for selection include the geographic balance of the venues as whole, the lack of good phytosociological and biodiversity data from the study region, the interest of potential participants and, most importantly, one or several reliable local organisers who preferably should have participated in at least one previous expedition. Persons interested in organising future EDGG Expeditions are encouraged to contact the EDGG Expeditions Coordinator (J.D.).

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Zygaena sp. on Phlojodicarpus sibiricus. Photo: M. Janišová

Serratula centauroides near lake Itkul is one of the species newly recorded for this part of "Khakassky" Reserve. Photo: O. Demina

Gentiana squarrosa, Leontopodium ochroleucum, Oxytropis bracteata, Rubus saxatilis, Orostachys spinosa, Dianthus versicolor and Allium strictum. Photo: O. Demina, D. Frank, M. Janišová and Ł. Kozub.

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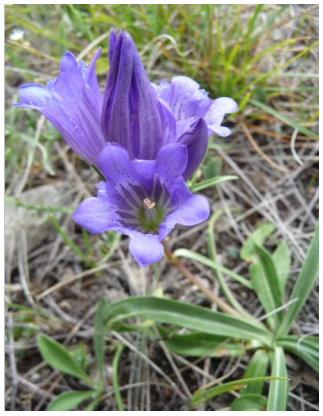
Lilium pumilum. Photo: R. Jaunatre

Ephedra monosperma. Photo: M. Janišová

Veronica incana and Veratrum nigrum. Photo: R. Jaunatre



Gentiana decumbens and Phlox sibirica. Photo: M. Janišová and R. Jaunatre

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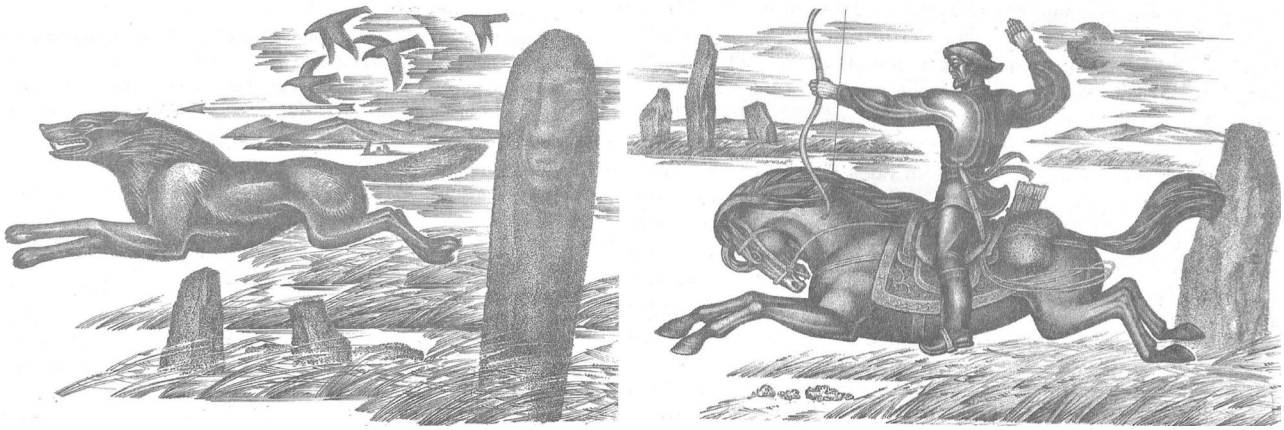

Source of the drawings: Myths and legends of the Khakass (Troyakov 2007)

Arseny Tarkovsky

Steppe

Earth swallows herself
And, knocking her head against the sky,
Patches the gaps in her memory
With humankind and grass.

Grass hides under the horse-shoes,
Soul in an ivory box;
Only word beneath the moon
Looms in the steppe

Which sleeps like a corpse.
Boulders on burial mounds -
Tsars playing at watchmen -
Drunk stupid on moonlight.

Word is the last to die.
When the drill of water pushes up
Through the subsoil's tough integument,
Sky will stir

And burdock's eyelash sigh,
Grasshopper's saddle flash,
Bird of the steppe comb,
Sleepy, its rainbow wing.

Then up to his shoulders in blue-grey milk
See Adam enter the steppe from paradise,
Restoring both to bird and stone
The gift of intelligent speech;

He recreated while they slept
Their palpitating names,
And now he breathes delirium of consciousness,
Loving, like soul, into grass.

1961

Арсений Александрович Тарковский

СТЕПЬ

Земля сама себя глотает
И, тычась в небо головой,
Провалы памяти латает
То человеком, то травой.

Трава - под конскою подковой,
Душа - в коробке костяной,
И только слово, только слово
В степи маячит под луной.

Почиет степь, как неживая,
И на курганах валуны
Лежат - цари сторожевые,
Опившись оловом луны.

Последним умирает слово.
Но небо движется, пока
Сверло воды проходит снова
Сквозь жесткий щит материка.

Дохнет репейника ресница,
Сверкнет кузнечика седло,
Как радугу, степная птица
Расчешет сонное крыло,

И в сизом молоке по плечи
Из рая выйдет в степь Адам
И дар прямой разумной речи
Вернет и птицам и камням.

Любовный бред самосознанья
Вдохнет, как душу, в корни трав,
Трепещущие их названья
Еще во сне пересоздав.

1961

22 July 2013

After arrival of the last expedition participants by flight from Moscow we gathered in the administration office of the Khakassia Reserve in Abakan. The press conference was organized for the Khakassian TV to inform the local public on the aims and participants of our EDGG research expedition. After refreshment, Nikolai Ermakov presented the expedition destinations. Due to the strong precipitation during the last months we could not visit higher altitudes of the Western Sayan Ridge (as originally planned). Instead, we travelled further north to the region Podzaploty. On the other hand, thanks to the rains, the steppes remained green and colourful up to and during our expedition. A small bus took us 160 km towards northeast to our first destination – Lake Itkul. We were accommodated in the nature reserve's visitor centre.

In the afternoon, we approached the first meadow steppes in the close vicinity of the visitor centre. Nikolai and Mariya trained us in the plant identification. Only some plants were familiar to those Europeans among us who visited Southern Siberia for the first time (e.g. Aster alpinus, Calamagrostis epigeios, Campanula glomerata, Carex humilis, Geranium pratense and Sanguisorba officinalis). Plenty of new plant names filled up our memo pads and brains. It started to be exciting!

EDGG Expedition 2013 in the Altai Mts.: Species-area sampling in dry grasslands

Plot No.: RU23 Subplot: NW Date: 27.07.2013 Page 1 of 2

Protocol: long Other author(s): Lubov, Nikolai

Location: Itkul Lake

Geographic "system": WGS 84 Precision: m Corner: NW

Longitude: 90° 09' 38.6" Latitude: 54° 37' 49.5" Altitude: 686 m a.s.l.

Aspect: 180° Inclination: 35° Microrelief: A cm Soil depth (Ex: A, B, C, D): A cm

Relief position: rocky slope Land-use: — (karst)

Vegetation type: MARINE TURISTIC PRESSURE (TRAMPLING, RUBBISH)

Comments: PETROPHYTIC COMMUNITY ON STEEP SLOPE

	Cover (%)	Ø height (m)	max. height (m)
T_3 (> 20 m)			
T_2 (> 10–20 m)			
T_1 (> 5–10 m)			
S (> 0.5–5 m)			
Herb layer	35	20	65
Cryptogam layer	–	-	-

	Cover (%)
Vegetation (total)	35
Litter	5
Dead wood	0
Stones and rocks (> 63 mm)	60
Gravel (2–63 mm)	90
Fine earth (< 2 mm)	5

No.	Layer	Taxon	1 cm	3.2 cm	10 cm	32 cm	1 m	3.16 m	Cover	10 m
1		Carex humilis	X						8	
2		Artemisia frigida			X				5	
3		Stipa zalesskyi				X			95	
4		Thalictrum foetidum				X			2	
5		Thymus asiaticus				X			1	
6		Gypsophila patrinii				X			5	
7		Veronica fruticulosa				X			2	
8		Festuca altina				X			2	
9		Abietinella abietina				X			05	
10		Hylocomium gmelinii				X			0,2	
11		Cerastium pumilum				X			0,5	
12		Kitagawia baicalensis				X			8	
13		Artemisia commutata				X			2	
14		Alyssum obtusifolium					X		903	
15		Stevenia chrysanthoides					X		0,1	
16		Ebenus cloides					X		1	
17		Thymus serpyllum					X		0,1	
18		Artemisia commutata					X		0,1	
19		Allium tenuissimum					X		0,01	
20		Goldbachia speciosa					X		0,05	
21		Kleistogenes squarrosa					X		0,1	
22		Saxifraga sibirica					X		0,1	
23		Iris humilis						X	0,5	
24		Poa botryoides						X	1	
25		Adenophora stenanthina						X	0,5	
26		Lilium pumilum						X	0,2	
27		Potentilla sericea						X	1	
28		Ephedra monosperma						X	1	
29		Bupleurum scorzonerifolium						X	0,5	
30		Potentilla acaulis						X	0,3	
31		Artemisia gmelinii						X	0,1	
32		Galium verum						X	0,04	
33		Potentilla tuberosa						X	0,1	
34		Saussurea salicifolia						X	0,3	
35		Viola dissecta						X	0,01	

23 July 2013

Lake Itkul is considered to be the cleanest of all Khakassian lakes. Its water is not salty like in the Lake Shira in the close vicinity. The fresh water provided us with the opportunity to swim and relax during our breaks at midday or in the evenings. On the lakeshores ancient burial mounds (kurgans) of different ages (mostly from the Bronze and Early Iron Age) are dispersed. The steppe was all around – and we wanted to study it in detail. The Khakassian steppe occurs in a gently undulating landscape – probably very similar to that of Central Europe in the late-glacial period – with endless grasslands and sparse patches of forests with Betula pendula and Larix sibirica, typically found on the northern slopes of the hills, where the snow cover lasts long enough to free the trees from the stress of having warm branches and frozen roots.

The first biodiversity plot we sampled together – imagine 14 botanists sampling a single plot! But the high quality of our relevés is not ensured only by a high density of botanist per square meter but much more by our sampling approach. In the nested-plot series we sample plots at several spatial scales. Along with the floristic composition of vascular plants and cryptogams, we recorded environmental data and collected the soil samples. After sampling several biodiversity plots our work was interrupted by a lunch break. We returned to the camp and enjoyed warm meal prepared by our Khakassian cook – the Russian cabbage soup called Shchi, a main course with a lot of meat and biscuits with candies at the end. In the afternoon we came back to the field to sample 10-m² standard plots on differing microlocalities but due to a storm we had to return.

25 July 2013

By a small bus we travelled 30 km towards southeast to the region with higher precipitation and subsequently more mesophilous species and trees.

The steppe itself is a patchwork of different habitats. In brief, the three most common types in the surveyed areas were i) the flat and gently sloping alluvial soils, dominated either by Stipa capillata or S. krylovii; ii) the steeper slopes, dominated by Hedysarum gmelinii, Helictotrichon schellianum and H. desertorum and iii) the windy ridges and upper parts of the south-facing slopes, where the wind and the sun sweep away the snow cover very quickly, exposing the plants to tremendous daily and seasonal temperature ranges. The cryo-petrophilous vegetation of these stony places is reminiscent of the Kalmia procumbens stands of the Alps, but here chamaephytes are almost absent, replaced by plants as beautiful as Orostachys spinosa, Dendranthema zawadskii, Phlox sibirica, Androsace dasyphylla, Arctogeron gramineum, Youngia tenuicaulis, Elytrigia lolioides, Kobresia filifolia or Kitagawia baicalensis. Interestingly, some abundant species of these habitats are also dominant or quite common in European high-mountain dry grasslands (e.g. Carex humilis, Aster alpinus and Seseli libanotis in the grasslands above the timberline in the Central Apennines), providing exciting insights in the historical development of these communities. The northern slopes in our study region were sometimes covered by loose Betula pendula forest with rich understorey vegetation. In this region, meadow steppes of European-Siberian type (Festuco-Brometea class) prevailed. They were extremely colourful thanks to flowering Hemerocallis minor, Castilleja pallida, Bupleurum multinerve, Vicia amoena, Veratrum nigrum or Gymnadenia conopsea. We sampled in two groups. The lunch was served in the field and tasted great.

In the evening we worked in the big hall of the visitor centre – we determined the plants, studied the literature, edited the recorded relevés and discussed while drinking the local beer "Abakanskoe".

26 July 2013

Our destination was the valley of Katjushkino near the village Son. Several decades ago, the local cooperative used this region quite intensively for agriculture and cattle grazing. Today, except for a small cattle herd and a couple of fields, the valley is almost unused. Again, we divided into two groups with one local expert supervising each of them. The plant names gradually became familiar to us. It was striking, how the same set of species was repeatedly recorded during the whole day! Fortunately, we also found some new species here: Phlojodicarpus sibiricus and Plantago urvillei, and dozens of rosettes for the evening determination session.

27 July 2013

We continued sampling the surroundings of the Lake Itkul during the hot morning and returned back to the visitor centre for lunch. In the afternoon, after another storm, we inspected the lakeshores and improved our Russian conversation skills. The most active members of our team continued in sampling meadow steppes in the neighbourhood. In the evening, as usual, the "bania" was prepared for us: a wooden house with three rooms, the first heated to 100º C for the sauna, the second with a tub of cold water and a tap with hot water for washing, and the third as a changing room.

28 July 2013

After the Sunday breakfast we were ready to travel to the second place of our fieldwork, located about 100 km towards northwest. Mariya returned to Abakan so the number of local experts in our team was reduced to one person. Fortunately, Svetlana with Masha and Lera accompanied us and took care of the food during the following days. From the simple food supplies they produced a real artistic work.

Nikolay told us that in Russia there are not roads just directions. Our journey to Podzaploty was a partial proof of this statement. The sudden change in local climate and biota immediately became clear after leaving the cars – we were attacked by thousands of hungry mosquitoes, midges and other invertebrates. Fortunately, our organizers were aware of this danger and provided us with repellents in advance.

Very soon after our arrival to a new destination, huge colourful flowers appeared in the steppe – our tents. Our bathroom was the near spring of fresh water and for the toilet we could chose any romantic place in the camp surroundings. Fortunately or unfortunately, most romantic places were full of both, strawberries (Fragaria viridis with many big and ripe fruits) and mosquitoes. We enjoyed one of the most advanced instruments in the wilderness – "rukomojku" – a container of water for washing hands. Some of us got used to it quite well.

29 July 2013

It was a day of climbing. One group of participants climbed to the highest peak near our camp. On the way they recorded relevés on steep and rocky slopes. Apart from that, on the edges close to the top they discovered a stand of Stipa orientalis – nice, rather a small species of this genus. Recording in this plot was almost a climbing exercise.

At the same time, the rest of participants worked at lower altitudes, but also in petrophytic vegetation. They climbed on a "Volcano" – the cone-shape porphyric hill, distinctive from the surrounding landscape. It was a locality of another interesting plant, Atraphaxis lanceolata, a shrubby species of the Polygonaceae family. From here, one could observe an amazing forest-steppe landscape with patches of Betula/Larch woods within the huge grassland extension: an astonishing "time-machine", as it can be viewed as a modern analogue of the landscape inferred from pollen records for the Last Glacial Maximum in many parts of Central and South Europe.

29 July 2013

This was the rainiest day during our expedition but sampling in wet conditions was not a problem for the skilled researchers. At least we could use all waterproof equipment we brought with us. Two groups worked around the lakes and near the porphyric hill. In the afternoon, we climbed the mountain over the camp again to sample the last relevés of this year's expedition. Beautiful views in all directions reminded us how huge and how empty the steppes surrounding us are. The most spectacular thing, however, was experiencing the immense, void steppe swaying in the wind; the gentle undulations of the Asiatic continental shield, where the mountains are now reduced to gently sloping hills, with sparse rocky outcrops. For tens of kilometres, the only human tracks were a few, scattered, proto-historic stones, the kurgans: monoliths erected to mark the burial of brave men and horses. A landscape unchanged for centuries, in which you expect to see appearing at any moment the Golden horde of Tartars, galloping navigators in a sea of grass; with no roads, just directions determined by the sun, the stars and the distant hills.

We enjoyed the feeling of being far away from everything, the majestic flights of the many birds of prey (e.g. Aquila heliaca, Buteo rufinus, Milvus migrans), the scurrying "sus-liks" (Spermophilus undulatus). During our trip, we saw small and black countryside villages; each house surrounded by a lopsided fence, probably built to define a human space in that superhuman, infinite land. The roads leading to those villages were long, straight, sleepy, no traffic, but sometimes crossed by crooked and surprisingly strong vehicles. We saw lakes without tributaries; their waters were clear as the rain that, in summer, makes the steppe flower ...

Pancakes awaited us in the camp!

Photos for the diary were provided by Reanaud Jaunatre, Dieter Frank and Monika Janišová

31 July 2013

In the morning we packed the tents and bags. Then, at ten, we had our last field breakfast. On the way to Abakan we said farewell to Nikolai (he went to Novosibirsk). After our arrival to Abakan we met Mariya, who prepared dinner for us. In the evening, Mariya organized a "sightseeing tour" through Abakan for us. We enjoyed the calm city atmosphere, old buildings and monuments contrasting with modern park equipment. Abakan made a good impression on us - it is well maintained, has a lot of greenery and urban parks, which in the afternoons are filled with people. We spent our night at the administration office of the Khakassia Reserve in Abakan.

1 August 2013

For most of the participants this was the day of returning home. Goodbye Khakassian steppe!