

**The Federal Scientific Center on the East Asia Terrestrial Biodiversity
FEB RAS, RUSSIA**

**Engineering Research Center of Chinese Ministry of Education
for Edible and Medicinal Fungi, CHINA**

The 1st International Conference

North East Asia Biodiversity

ABSTRACTS

September 17–21, 2018

Vladivostok

RUSSIA

THE FEDERAL SCIENTIFIC CENTER ON THE EAST ASIA TERRESTRIAL
BIODIVERSITY FEB RAS, RUSSIA
ENGINEERING RESEARCH CENTER OF CHINESE MINISTRY OF EDUCATION
FOR EDIBLE AND MEDICINAL FUNGI, CHINA

The 1st International Conference on

NORTH EAST ASIA BIODIVERSITY

SEPTEMBER 17–21, 2018
VLADIVOSTOK, RUSSIA



Note about the content of the abstract book

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The Federal Scientific Center of the East Asia Terrestrial Biodiversity (159 Stoletiya Avenue, Vladivostok, Russia) hosts the Conference.

ISBN: 978-5-600-02228-7

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Asia Terrestrial Biodiversity FEB RAS

Printed by YAMAICA LLC

PREFACE

East Asia is a part of Earth populated with many nations, and it harbors rich biological diversity of global importance. This biodiversity provides a wide range of ecological, economic, social, and cultural services, which have sustained human society in the region over thousands of years and contribute to economic development. Since biodiversity recognizes no national borders, international cooperation is increasingly important for addressing the common challenges in nature understanding and conservation.

The aim of the conference initiated by the Federal Scientific Center on the East Asia Terrestrial Biodiversity of FEB RAS (RUSSIA) and Engineering Research Center of Chinese Ministry of Education for Edible and Medicinal Fungi (Jilin Agricultural University, CHINA) was to share knowledge and experiences in the broad field of the North East Asia biodiversity among scientists in a interdisciplinary manner, create networks among specialists and institutions all over the world in order to improve our understanding of regional biodiversity, integrate research outputs into conservation projects and sustainable technologies, to identify further research needs and perspectives.

Russia and China were among the first countries which have embodied the idea of transboundary reserves for migrating birds and for big cats. We expect that the regular meeting in the form of such conference will produce a fruitful opportunity to create new international teams and areas to study global and transboundary aspects of biodiversity, to create the mitigation strategies for reducing the unpleasant consequences of climate change, and even to establish the joint enterprises with new technologies for land use, flood and erosion control as well as for conservation of rare and endangered species.

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Session 1

Biodiversity of terrestrial and freshwater flora, fauna, and fungi

**GENETIC DIVERSITY AMONG WILD AND CULTIVATED
PANAX GINSENG MEYER BASED ON CHLOROPLAST DNA DATA**

Irina Yu. ADRIANOVA¹, Elena A. VASYUTKINA¹, Alexander A. BONDAR²

¹ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

² SB RAS Genomics Core Facility, Institute of Chemical Biology and Fundamental Medicine SB RAS, Novosibirsk, Russia.

Panax ginseng Meyer is a medically important plant species and is widely used in cultivation in the northeastern Asia. The genetic diversity of wild and cultivated ginseng was estimated using sequence variation of chloroplast DNA regions such as *ycf1a*, *trnH-psbA* and *matK-rps16*. These cpDNA regions are traditionally used for DNA barcoding of plants. In this study we analyzed ginseng from natural populations of the Primorye Territory. A total of 5135 bp of aligned chloroplast sequence were obtained, comprising 668, 483 and 3984 bp for *ycf1a*, *trnH-psbA* and *matK-rps16*, respectively. These sequences were compared with accessions of wild and cultivated *P. ginseng* from China and Korea downloaded from GenBank. The sequences of these cpDNA regions of *P. vietnamensis* Ha et Grushv. were used as an outgroup. The analysis revealed seven haplotypes in *P. ginseng* that were separated from outgroup by fifty-seven mutational steps. High frequency of occurrence has been in haplotypes H1 (44 %) and H4 (34 %). Haplotype H1 was represented primarily wild ginseng from the Primorye Territory, and all representatives from China, and two from Korea. Haplotype H4 was revealed in two plants from the Primorye Territory (Dalnegorsk population) and nine accessions from Korea. The rest of haplotypes belonged to ginseng populations from the Primorye Territory (H2, H3, H5, H6) and one sample of wild ginseng from south of Korea Peninsula (H7). All haplotypes of *P. ginseng* from the Primorye Territory were at a distance of one mutational step from H1 and formed a star-like network. Such structure may indicate on recent divergence of these populations. As for ginseng from Korea three haplotypes were identified: two for cultivated accessions and one for wild plant. It was interesting that all sequences of ginseng from China, belonging to four different landraces, had one haplotypes and this consistent with conclusion that Chinese landraces were not domesticated independently.

In general, it was found that wild ginseng from the Primorye Territory has greater haplotypic diversity in compare with wild and cultivated ones from China and Korea by four cpDNA regions studied. Thus, it can be assumed that domestication significantly reduces genetic diversity.

**BIODIVERSITY OF SMALL FRESHWATER BIVALVES
(MOLLUSCA: PISIDIOIDEA) OF THE KHINGANSKY STATE
RESERVE (AMUR REGION, RUSSIA)**

Irina V. BALAN¹, Mariana O. SHARYI-OOL²

¹ *Khingansky State Nature Reserve, Arkhara village, Amur Region, Russia*

² *Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia*

We studied a small freshwater bivalve mollusks of the families Sphaeriidae, Pisidiidae, Euglesidae (Bivalvia: Pisidioidea) within the Khingansky reserve and the Amur Region adjacent territories. A lot of clams were collected during the period 2006–2016 in various natural water bodies of different ecological types, lakes and rivers, creeks and fens in the plain, foothills and mountainous parts of reserve. In this study, we examine original material. Almost 550 specimens were fixed in 75 % alcohol. Materials were deposited in the Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok. The following parameters were measured on a stereoscopic optical microscope using a calibrated ocular micrometer: length, height, width of shell. Shell sculpture, features of hinge, ligament, muscle scars and pores were investigated by SEM methods. We used Russian taxonomic system. Fourteen species of small bivalves from six genera in three Pisidioidea families have hitherto been recorded for reserve. The Sphaeriidae are represented by three species, the Pisidiidae by one species, the most numerous were the Euglesidae, with ten species by five genera. Only one endemic species *Amureuglesa khurbaensis* (Zatrawkin, 1987) was found in the different types of waters occurring in mountainous and plain parts of reserve. Two endemic species *Euglesa koltschomensis* Zatrawkin, 1987 and *Henslowiana izzatullaevi* (Zatrawkin, 1987) were found in the rivers. Five bivalve species with fragile shells lives in fen water bodies: *Musculium creplini* (Dunker, 1845), *Cyclocalyx cor* (Starobogatov et Streletzkaja, 1967), *C. hinzi* (Kuiper, 1975) *C. johanseni* (Dolgin et Korniushev, 1994), *C. lapponicus* (Clessin in Westerlund, 1873). *Musculium compressum* Mousson, 1887 (Sphaeriidae) was recorded in the Khingansky reserve for the first time. The majority of species are distributed in the Holarctic and Palaearctic Region, while the other species have distribution in the Amur River basin.

This study was supported by Khingansky State Nature Reserve (V.V. Kopylov).

THE GENUS *SALIX* IN THE FLORA OF THE RUSSIAN FAR EAST

Vyacheslav Yu. BARKALOV, Marina M. KOZYRENKO

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Salix L. is the largest genus in the family Salicaceae, comprises 300–450 species widespread mainly in cold and temperate regions of the northern hemisphere, with diversity in the northern latitudes of Eurasia and North America, as well as in the mountains of China (Skvortsov, 1968; Argus, 1997, 2010, Fang et al., 1999). There are about 80 species in the Russian Far East.

One of the difficulties in the systematics of *Salix* have been noted comparative ease of occurrence of interspecific natural hybrids (Skvortsov, 1966), that was particularly characteristic for relatively young subgenera *Chamaetia* and *Vetrix*. When this, according to A.K. Skvortsov (1968), natural hybrids between species of different sections arise perhaps more often than between species within one section. This is, to some extent, creates difficulties and in clarifying the phylogenetic relationships of species based on molecular markers. There are still contradictions between classification schemes based on morphological and molecular characters. Subgeneric classification within *Salix* and the situation of previously recognized genera *Chosenia* and *Toisusu* remain under continuous revision. There is no clarity, both in respect of the status of some species, and their sectional affiliation.

Our study of the North-East Asian willows species from three subgenera: *Salix*, *Chamaetia* and *Vetrix*, as well as genus *Chosenia* based on nuclear and chloroplast DNA sequence data confirmed the conclusions of another authors (Leskinen et al., 1999; Azuma et al., 2000; Chen et al., 2010; Hardig et al., 2010; Wu, 2015; Lauron-Moreau, 2015) that the genera *Chosenia*, *Salix* and *Toisusu* form a monophyletic group. A weak divergence was found only between the species of subgenus *Salix*, and relationship of the subgenera *Chamaetia* and *Vetrix* remained unresolved – in most species the sequences differed by several substitutions or were identical.

Analysis of variability of the nucleotide sequences of intergeneric spacers (*trnS-psbZ*, *trnC-petN* and *petN-psbM*) of the cpDNA from closely related species of the *Salix* aggr. *berberifolia* (*S. berberifolia*, *S. fimbriata*, *S. kamtschatica*, *S. kimurana*, *S. vyshinii*, *S. tschuktschorum*) revealed very low genetic differentiation or lack thereof (Barkalov, Kozyrenko, 2017). The results indicate a relatively recent colonization of the Far Eastern part of the area distribution of *S. berberifolia* in broad sense, probably Late Pleistocene time. Indirect fact of this can serve as a weak morphological separateness of *S. berberifolia* species complex. A complex “barberryleaved” willows can be conditionally divided into two closely related groups. The first group includes *S. berberifolia*, *S. fimbriata* and *S. kamtschatica*, the second one – *S. tschuktschorum*, *S. kimurana* and *S. vyshinii*. The two latter species probably are conspecific.

Population structure and phylogenetic relationships of 19 *Salix* species from

northeast Asia, which were attributed by different authors to the section *Myrtosalix* of subgenus *Chamaetia*, have been investigated based on sequence data from the *trnS-psbZ*, *trnC-petN* and *petN-psbM* intergenic spacers of cpDNA. The genealogical network of haplotypes showed the absence of any phylogenetic groups. The section *Myrtosalix* includes species *S. jurtzevii*, *S. khokhriakovii*, *S. nummularia*, *S. recurvigemmis* that may have been derived from intra- or intersectional hybridization along with introgression and allopolyploidy (a reticulate evolution). The presence of common haplotypes in most of the species studied indicates a common origin and relatively recent divergence, and the presence of several different haplotypes indicates that section *Myrtosalix* is possibly heterogeneous.

To determine interspecific relationships in the genus *Salix* were used sequences of ten regions (*petG-trnP*, *petN-psbM*, *psaA-ycf3*, *psbM-trnD*, *rpoB-trnC*, *trnC-petN*, *trnD-trnT*, *trnS-psbZ*, *rbcL*, *matK*) of the cpDNA and the ITS rDNA of 68 representatives of 57 species. The sequences of *Populus suaveolens* were used as outgroup. The total length of concatenated sequences of the 11 regions was 7442 sites. The alignment contained 6257 monomorphic sites, 297 variable sites, and 94 of them were parsimony-informative. Nucleotide substitutions and indel variations revealed 67 haplotypes (H1–H67), of these only one haplotype (H57) was common in *S. udensis* and *S. schwerinii*. To reveal the genealogical relationships between the haplotypes by method of the median joining (MJ) a network was constructed, which lack phylogenetic structure. Haplotypes of *S. pseudopentandra* (H45, H46) are close to *Populus suaveolens* that are likely to be ancestral haplotypes against all other *Salix*. Subgenus *Salix* is the most primitive within genus *Salix*, with a number of similarities with poplars (Skvortsov, 1968); *S. pseudopentandra* has buds also long acuminate and adhesive. The longest branches have *S. cardiophylla* (H14), *S. arbutifolia* (H4) and *S. nipponica* (H38) – 13, 27 or more mutational steps, respectively. The loop structures (alternative connections) in the network arise as a result of the reverse or parallel mutations and indicate the polyvariance of possible genealogical connections between haplotypes. The presence of the loop structures is mainly due to recombination, the prerequisites of which are introgressive hybridization.

Thus, the subgenus *Salix* is not monophyletic; *S. nipponica* (sect. Triandrae) and *S. cardiophylla* (sect. Urbanianae) phylogenetically close to *S. arbutifolia* and other *Salix*, whereas, *S. pierotii* (sect. Subalbae) and *S. pseudopentandra* (sect. Pentandrae) significantly distant from all. The species belonging to the section Triandrae differ from others in the subgenus *Salix* mainly bark that resembles *Chosenia* bark (bark of old trees is peeled from the thin plates), and the particular structure of the anthers (Skvortsov 1966, 1968). The flowers *S. triandra* and *S. nipponica* have usually three stamens, but there are also specimens with two, four or five stamens (Fang et al. 1999; Ohashi 2001). Perhaps, section Triandrae deserves giving it the status of the subgenus. Section Urbanianae occupies the most isolated position in the subgenus *Salix* (Skvortsov, 1968). The representative of this section – *S. cardiophylla* differs from all species of subgenus *Salix* by

generative organs.

The anatomy of leaves in the species of the subgenus *Chamaetia* (except sect. *Chamaetia*) is mostly monomorphic and similar to that of the species of the section *Hastatae* from subgenus *Vetrix* (Skvortsov, Golysheva, 1966). The boundary between the subgenera *Chamaetia* and *Vetrix* is not clear, and many of the characters separating them, Skvortsov (1968) explained by adaptation to the arctic and alpine environments. He did not exclude the polyphyletic origin of the subg. *Chamaetia*. In our genealogical network, the subgenera *Chamaetia* and *Vetrix* form one large group of species.

**WILD BOARS (*SUS SCROFA*) AS THE HOSTS AND
DISTRIBUTORS OF *HAEMOPHISALIS LONGICORNIS* AND
DERMACENTOR SILVARUM TICKS**

Yury A. BELOV¹, Elena G. BURUKHINA², Tatyana V. MOSKVINA³,
Egor M. SHCHELKANOV³, Aleksei L. SUROVIY⁴, Dmitry V. PANKRATOV⁴,
Pavel V. FOMENKO⁵, Vladimir G. DEDKOV⁶, Olga B. ROMANOVA²,
Irina V. GALKINA³, Mikhail Yu. SHCHELKANOV^{1,2,3}

¹ Federal Scientific Center of East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

² Federal Budget Institution of Health "Center for Hygiene and Epidemiology in Primorye Territory", Vladivostok, Russia

³ Far Eastern Federal University, Vladivostok, Russia

⁴ Department for the protection, control and regulation of the use of wildlife objects of the Administration of Primorye Territory, Vladivostok, Russia

⁵ Amur Branch of the World Wide Fund for Nature, Vladivostok, Russia

⁶ Pasteur Institute, Saint-Petersburg, Russia

Two species of *Ixodidae* (*Acari: Parasitiformes*) ticks – *Haemaphysalis longicornis*, and *Dermacentor silvarum* – are well-known inhabitants of the south part of Primorye Territory (moreover – the south part of Khasan district). Until now, these species have been associated with sika deer (*Cervus nippon*) and have not been found in the more Northern territories due to insufficient soft conditions for overwintering.

During planning monitoring of wild boar (*Sus scrofa*) diseases we have found a great number of *H. longicornis* and *D. silvarum* overwintering on the ears of wild boars (November–March). Extensiveness coefficient was about 70–90%, intensiveness – about several tens or more than a hundred ticks per host animal. *H. longicornis* was detected in both imago and nymph stages, whereas *D. silvarum* – only in imago stage. Parasitizing imagos were semi-engorged or unengorged. The number of males exceeds the number of females by 5–10 times.

Wild boars with ectoparasites were found far beyond usual (described in scientific literature) areal of *H. longicornis* and *D. silvarum*: e.g. in the Northern part of Khasan district, Nadezhdinsky district, Ussuriisk urban district, Anuchinsky district and Chuguevsky district. Thus, using homoeothermic hosts as so to say "movable thermostats" or distributors these relatively Southern tick species could penetrate into more Northern territories together with infection agents, for which they are vectors as well.

The phenomenon discovered needs to revise accepted concepts of areal borders for *Ixodidae* ticks and infection agents associated with them.

The study was supported by the Program of fundamental research of the Far Eastern Branch of the Russian Academy of Sciences «Far East» (2018–2020), project 18-5-060.

FEATURES OF THE MYCOBIOTA OF THE KUNASHIR ISLAND

Evgeniya M. BULAKH, Nadezhda V. BUKHAROVA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Kunashir Island is the southernmost island of the Great Ridge of the Kuril Islands. It is formed by four active volcanoes. The climate is humid continental. Forests occupy up to 70 % of the total area of the island. The vegetation mostly consist of spruce (*Picea jezoensis*, *P. glehnii*), fir (*Abies sachalinensis*), and mixed deciduous forests with lianas and Kuril bamboo underbrush. The mountains are covered with cedar pine (*Pinus pumila*), herbaceous flowers or bare rocks.

The fungi of the Kunashir Island been studied insufficiently. There were known only 118 species of the Basidiomycetes fungi in this territory before our research (Koval, 1960; Nikolaeva, 1963; Parmasro, 1965; Kōljalg, 1996; Bulakh et al., 1999).

The material was collected in August–September 2016–2017. Our research covered the central and southern part of the island.

Fungi on the island are found everywhere. In the forests, its mostly grow in places with a rare cover of bamboo, on the near-trunk circles near tree trunk, on the edge of the forest.

To date, 274 species of agaricoid and 105 species of aphylloroid fungi are known for the territory of Kunashir Island. Of these, 247 species of agaricoid and 43 species of aphylloroid fungi are first found in this territory.

Two species of the genus *Laetiporus* (*L. cremeiporus* and *L. montanus*) were previously classified as *L. sulphureus*. The East Asian species *L. cremeiporus* is occurs on hardwoods, most often on oak. The mountain species *L. montanus* is inhabit on conifers.

The fungi mycorrhiza-forming with fir trees prevail on the island, less – with cedar pine, spruce, birch and oak. The high humidity of the substrate promotes abundant forming of fruitbodies of litter saprotrophs – the destroyers of plant litter – leaves and bamboo trunks: *Marasmius epiphyllus*, *Favolaschia sachalinensis* and *Tetrapyrgos subdendrophora*. For the first time, the fungus *Marasmiellus alliiodorus* was found, abundantly bearing on the bark of branches of old trunks of the relict tree *Taxus cuspidate*. Such fungi as *Gymnopilus liquiritiae*, *Fomitopsis pinicola*, *Pycnoporellus fulgens* are common wood destroyers of fir.

Rare species that are listed in the Red Book of the Russia (2008), such as *Chroogomphus tomentosus*, *Porphyrellus porphyrosporus*, *Strobilomyces strobilaceus*, *Polyporus umbellatus* and *Dictyophora duplicata* were found on the Kunashir Island.

In addition to these species, Kunashir also has species listed in the Red Data Book of the Sakhalin region (2005), such as *Harrya chromapes*, *Cyanoboletus pulverulentus*, *Rhodotus palmatus*, *Amanita caesarea* var. *caesareoides*, *Bondarzewia mesenterica*, *Russula granulata*, *Catathelasma imperiale*.

Sparassis crispa, listed in the Red Book of the Sakhalin Region, was marked

previously on the Kunashir Island. According to modern, it was found that the Far Eastern samples belong to *S. latifolia* (Desjardin et al., 2004; Wang et al., 2004). The species is distributed broadly in East Asia and grows in association with conifers.

The work is partially supported by RFBR grants: 18-04-00098 A «Identification and assessment of the status of relict broad-leaved forests of the islands of the Russian Far East (Sakhalin and the Kuril Islands)», and 15-29-2382 «Mycobiota of the Far East of Russia: revision of biological diversity as a unique component of northeast Asia».

**CONCEPT OF BACKBONE TAXONOMY
FOR VASCULAR PLANTS OF ASIAN RUSSIA
IN FRAME OF THE MAPPING ASIA PLANTS PROJECT**

Victor V. CHEPINOVA^{1,2}, Vladimir M. DORONKIN³, Jianhua XUE⁴, Keping MA⁴

¹ V.B. Sochava Institute of Geography SB RAS, Irkutsk, Russia

² Irkutsk State University, Irkutsk, Russia

³ Central Siberian Botanical Garden SB RAS, Novosibirsk, Russia

⁴ Institute of Botany, Chinese Academy of Sciences, Beijing, China

Asia is the largest and apparently floristically richest continent in the world. The ambitious international project Mapping Asia Plants (MAP) initiated in 2015 is aimed to create a better mapping infrastructure for plant diversity conservation in Asia. The MAP intends to provide access to geographic range maps, diversity maps, species checklists, standardized botanical observation datasets etc. At the first stage it is important to produce clean checklists for sub-parts of Asia and Asian countries. Asian Russia occupies the northern part of the continent from 42 to 81 degrees of north latitude between Ural Mts. in the west, to the Pacific coast in the east. Covering 30% of the Asian continent, Asian Russia is not as rich as smaller countries located to the south. According to the Checklist of flora of the Asian part of Russia (2012), here occur about 7000 vascular plant species. In frame of the MAP project, we gathered data from different publications (floras, check-lists etc.) dedicated individual regions of Asian Russia. Currently, 45 sources have been checked and species lists transferred to the Excel spreadsheet format. During the list compilations, it became evident that species concepts are widely differs among authors. In some cases, researchers prefer accept species *sensu lato*, or distinguish subspecies within broad species. Other authors do not use rank of subspecies and accept all geographical races as separated species. Our task was to choose species concept that would help to compile all the regional lists into a single list of species. Simple use of global taxonomical sources, such as The Plant List (www.theplantlist.org), Catalogue of Life (www.catalogueoflife.org), or Tropicos (www.tropicos.org) we found insufficient for our purposes. In many cases, global databases use the broad species concept, suitable for reviews and analysis in global scale, but such approach may not be satisfactory for regional researchers. More convenient is a monotypic species concept known in Russia as the V.L. Komarov species concept. The concept was developed by Komarov in the beginning of XX century during his work in Manchuria and Kamchatka and is still the most popular among scientists of the Far East. Another innovation introduced by Komarov was the concept of species series which cover closely related species. To date, the aggregates proposed by I. Manton (1958) are widely used in central-European literature (Ehrendorfer 1973; Danihelka et al. 2012; etc.). Species aggregates are similar to series, but have more practical goals, while may also include similar species that are difficult to separate. Aggregates are frequently used in phytosociology, community ecology

and nature conservation studies and also can be useful for purposes of the MAP project. Using species aggregates will allow us to abandon subspecies and accept them at species rank that makes the taxonomy more simple and practical, and indeed binominal, as it was originally introduced by K. Linnaeus.

**THE IMPACT OF THE KHAMAR–DABAN NEMORAL REFUGIUM
(THE SOUTH OF EASTERN SIBERIA)
ON THE BAIKAL REGION BIODIVERSITY**

Victor V. CHEPINOVA^{1,2}, Marina V. PROTOPOPOVA³,
Vasily V. PAVLICHENKO³, Nikolay N. LASHCHINSKIY⁴, Alla V. VERKHOZINA³

¹ V.B. Sochava Institute of Geography SB RAS, Irkutsk, Russia

² Irkutsk State University, Irkutsk, Russia

³ Siberian Institute of Plant Physiology and Biochemistry SB RAS, Irkutsk, Russia

⁴ Central Siberian Botanical Garden SB RAS, Novosibirsk, Russia

The Khamar–Daban Ridge is an eastern outpost of South Siberian nemoral refugia complex. The ridge is a part of the Lake Baikal mountain frame. It extends along the southern and south-eastern shore of the Lake. Sublatitudinal orientation of the ridge performs a barrier function for the Atlantic atmospheric masses coming to the region from the west. Interception of greater amount of rainfall in comparison with the surrounding territories promotes the formation of a more humid and less continental climate on the northern slope of the ridge. Such a special climate determined suitable condition for the long-term conservation of mesophyte species and for forming original community types on the ridge. Among 27 plant species traditionally considered as nemoral relicts in Southern Siberia, the distribution of seven species is limited mostly by the Khamar–Daban ridge. There are about ten endemic (or subendemic) species for the Khamar–Daban (e.g. *Aconitum sukaczewii*, *Allium chamarense*, *Aegopodium latifolium*, *Poa irkutica*, *Rhaponticum chamarense*, *Swertia baicalensis*, *Tridactylina kirilowii*). Our studies showed that there are several original taxa which still remain not described so far. Some of relict species, mainly of East–Asian origin (*Anemone baicalensis*, *Eranthis sibirica*, *Waldsteinia ternata*), are apparently more phytocoenotically active in Khamar–Daban than in other fragments of their distribution range in Southern Siberia. Number of specific species play the active role in forming of forest and meadow vegetation, and determine strong regional species composition of plant communities. There are at least three original associations in forest vegetation (class *Asaro europaei-Abietetea sibiricae* Ermakov, Mucina et Zhitlukhina 2016) to be newly described on the ridge. Even more peculiar are tall–forb, tall–grass, and fern communities phytosociologically treated within the Eurosiberian class *Mulgedio-Aconitetea* Hadač & Klika in Klika & Hadač 1944). Based on significant floristic differences, seven new associations within a new alliance *Poo irkuticae-Geranion krylovii* (prov.) are proposed. Furthermore, the humid climate on the ridge promotes introducing mesophytic neophytes thereby continuing to play the role of a refugium for the adventive plants. Among about 375 neophytes in Baikal region, 64 species were firstly registered on the Khamar–Daban foothills. The most of them are naturalized and distribution of 33 species in the region is remains limited by the ridge. Thus, the Khamar–Daban nemoral refugium contributes to

biodiversity of the region at different levels of organization: species, communities and, probably, at the landscape level as well.

The work was supported by the Russian Foundation for Basic Research (projects No. 16-05-00783a, 16-34-60135_mol_a_dk, 16-04-01246a, and 17-44-388084p_a) as well as by the Russian Science Foundation (project No. 17-74-10074).

**ASSESSMENT OF THREATS TO THE VASCULAR PLANT
DIVERSITY OF NATURAL COMMUNITIES OF REINEKE ISLAND
FROM THE ALIEN SPECIES *RUDBECKIA HIRTA* L. AND
CENTAUREA JACEA L. (ASTERACEAE) (VLADIVOSTOK, RUSSIA)**

Margarita N. CHIPIZUBOVA

Pacific Geographical Institute, FEB RAS, Vladivostok, Russia

Island ecosystems are very vulnerable to the impacts of both natural and anthropogenic factors, often leading to their catastrophic rearrangements.

Alien species in natural and semi-natural communities is one of such factors and can bring to the considerable, up to the complete transformation, to changes of ecosystems.

The area of Reineke Island is 457 hectares. Island relief is low—mountains, maximal mark of 149 m. The island's area covered with the forest is 11.4 % (in 1889 – 70 % [1]), post-forest waste grounds and secondary shrubby thickets – 34 %, meadows – 49 %.

Rudbeckia hirta L. and *Centaurea jacea* L. are alien species for Russia's Far East. In Reineke Island (Peter the Great Bay, Japan Sea, Vladivostok, Primorskii Krai), *R. hirta* and *C. jacea* are known from 1980th years [2]. The time and manner of its occurrence on the island could not be established.

R. hirta is northern american species, grows in prairie, plains, meadows, pastures, savannahs, woodlands edge, opening in dry and moist habitats. *R. hirta* can become aggressive if given too perfect an environment and not enough competition [3].

C. jacea is european species, the perennial grassy plant, grows on meadows, in steppes, on edges, glades, roadsides of roads, waste grounds, cuttings, among bushes, but mostly in dry habitats [4, 5]. *C. jacea* can be an aggressive invader, for example, in United States [6].

In 1974–1977 plant communities with *R. hirta* cover area about 72 hectares or 15,76 % of island territory in post-forest disturbed plant aggregations mainly. *R. hirta* was very aggressive due to human economic activity: most importantly the mowing. *C. jacea* grows in small quantities.

After many years of decline in economic activity in 2016–2017 *R. hirta* cover area about 3 hectares or 0,7 % of island territory in post-forest disturbed plant aggregations and roadsides of dirt roads. Therefore, *R. hirta* reveals itself as a pioneering plant mainly.

More than in 40 years after find in Reineke Island distribution of *C. jacea* is limited to small sites of meadows and roadsides of dirt roads for 0,02 % of the island territory. The level of invasive activity *C. jacea* in Reineke Island which is represented low.

Thus, in the absence of destructive economic activities in the plant natural

communities in Reineke Island threats are insignificance to its floristic diversity from the species *R. hirta* and *C. jacea* there.

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THE MORPHOLOGY OF THE FUR OF SIBERIAN TIGER (*PANTHERA TIGRIS ALTAICA*)

Dmitry A. DERUNOV¹, Aleksandra R. TITOVA², Tatyana V. MOSKVINA²,
Irina P. KOROTKOVA³, Irina V. GALKINA², Elena N. LUBCHENKO⁴,
Yury G. VOLKOV², Dmitry V. PANKRATOV⁵, Pavel V. FOMENKO¹,
Mikhail Yu. SHCHELKANOV^{2,6}

¹ Amur Branch of the World Wide Fund for Nature, Vladivostok, Russia

² Federal Scientific Center of East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

³ Primorskaya State Academy of Agriculture, Ussuriisk, Russia

⁴ Regional State Budget Institution "Veterinary Anti-Epizootic Service in Primorye Territory",
Vladivostok, Russia

⁵ Department for the protection, control and regulation of the use of wildlife objects of the
Administration of Primorye Territory, Vladivostok, Russia

⁶ Far Eastern Federal University, Vladivostok, Russia

The Siberian tiger (*Panthera tigris altaica*) is the endangered species. The population estimated about 500 animals in the Russian Far East. The main reasons of population decreasing include poaching, hunting, habitat destruction. Fur and hairs are the most frequent materials using in criminal expertise, particularly for the evidence of poaching.

Both scanning electron microscopy and PCR analyses are the most sensitive methods for fur species identification. However, relate to high costs of these methods and common absence of specialists, it is necessary to develop more simple methods of fur identification suitable in the field conditions. The aim of this study is to investigate morphological structure of the fur of different species including Siberian tiger.

The morphological structures of Siberian tiger, domestic dog and cat fur from the different regions of the body including head, neck, shoulder-blade, back, abdomen, tail and foot were investigated using light microscope. The measurement of fur was provided using Axio Vision.

Four different parameters were measured such as fur width, hair shaft width, cuticle width, ratio hair core/hair width, cuticle width/hair width. Our results showed that fur of Siberian tiger had higher width of hair shaft, cuticle and fur width than other two species. Width of hair shaft was 130.1–244.1 nm, cuticle – 62.7–110.3 nm, fur width 314.3–463.9 nm. The higher width for all parameters (cuticle, shaft) was registered for fur taken from foot, the lowest width – for fur taken from back. The width of fur and its structures was significantly lower in cat and dog. In cat width of hair shaft was 19.1–65.9 nm, cuticle – 5.6–44.5 nm, fur width was 28.4–156.4 nm. The higher width for all parameters (cuticle, shaft) was registered for fur taken from abdomen the lowest width – for fur taken from head. In dog width of hair shaft was 46.4–95.7 nm, cuticle – 7.3–9.6 nm, fur width 63.0–112.2 nm. The higher width for all parameters (cuticle, shaft) was also registered

for fur taken from abdomen the lowest width – for fur taken from head. The ratio hair core width/cuticle width was also distinguished in all species. The higher ratio was recorded for Siberian tiger; it was 2.1 ± 0.2 nm, for cat it was 1.7 ± 0.3 nm, and in dog – 1.2 ± 0.1 nm. The similar tend was also appeared for ratio cuticle width/hair core width. The higher ratio was recorded for Siberian tiger; it was 1.1 ± 0.2 nm, for cat it was 0.7 ± 0.4 nm, and in dog – 0.3 ± 0.1 nm.

Thus, we conclude that the simplest fur measurement is quite sensitive method for identification of fur origin.

The study was supported by the Program of Fundamental Research of the Far Eastern Branch of the Russian Academy of Sciences «Far East» (2018–2020), project 18-5-060.

**NORTH-EASTERN ASIA
AS A MODERN GENETIC SUBGROUP GENERATION CENTER
FOR HIGHLY PATHOGENIC AVIAN INFLUENZA A / H5 VIRUSES
(*ORTHOMYXOVIRIDAE, INFLUENZAVIRUS A*)**

Mariya N. DUNAEVA^{1,2}, Kirill A. SHARSHOV³, Ivan A. SOBOLEV³,
Vera A. LEDNEVA¹, Dmitry V. PANKRATOV⁴, Aleksei L. SUROVIY⁴,
Irina V. GALKINA², Pavel V. FOMENKO⁵, Yury N. ZHURAVLEV¹,
Aleksandr M. SHESTOPALOV³, Mikhail Yu. SHCHELKANOV^{1,2,6}

¹ Federal Scientific Center of East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia;

² Far Eastern Federal University, Vladivostok, Russia

³ Research Institute of Experimental and Clinical Medicine SB RAS, Novosibirsk, Russia

⁴ Department for the protection, control and regulation of the use of wildlife objects of the Administration of Primorye Territory, Vladivostok, Russia

⁵ Amur Branch of the World Wide Fund for Nature, Vladivostok, Russia

⁶ National Scientific Center of Marine Biology, Vladivostok, Russia

Hemagglutinin type 5 of highly pathogenic avian influenza A (HPAI) virus (*Orthomyxoviridae, Influenzavirus A*), which is distributed nowadays all over the world and is the main epizootic threat for poultry as well as wild birds, was appeared in the South Chinese province of Guangdong. This hemagglutinin of prototype A/goose/Guangdong/1/1996 (H5N1) strain changing many times during genetic shifts and generating new genetic subgroups participated in various reassortations; it still circulates and evolves.

New genetic subgroups are formed every winter of Northern Hemisphere when the virus is forced to change to avoid collective immunity in dense populations of overwintering birds. In spring, migrating birds introduce small amounts of new viral subgroups into nesting areas in Northern Eurasia. Even these small amounts of new subgroup origin are enough to amplify in the non-immune juvenile bird populations and accumulate in noticeable amounts closer to the autumn – to the new periods of the migration of wild birds. This natural process takes place annually and is the basis for the emergence of new genetic subgroups.

Starting from the winter of 2013–2014, the center for the formation of new genetic subgroups shifted from South–Eastern to North–Eastern Asia. During referred overwintering period HPAI/H5N8/2.3.4.4 subgroup was appeared in the Korea Peninsular. In autumn 2014 one of the genotype, <D3>, belonging to HPAI/H5N8/2.3.4.4 was found throughout the migration routs of wild birds in Republic of Sakha (Yakutia) (A/wigeon/Sakha/1/2014), the Netherlands, Germany, great Britain and Italy; migration of birds to the East initiated the epizootic process in Japan, in the North direction – in the North America, where genotypes HPAI/H5N8/2.3.4.4/<AmN1> and <AmN2> were formed as result of reassortation with American variants. In the next overwintering period it was the North–Eastern Asia where new genotypes of HPAI/H5N8 and HPAI/H5N6 were appeared.

Monitoring of influenza A virus in the Far East allows detecting the wide penetration of new variants into Northern Eurasia. Such monitoring is conducting nowadays in the frame of the Network Project of Russian Scientific Foundation “Forecasting of Avian Influenza spreading in Russia and Japan for prevention and control: Involvement of East Asian – Australasian Flyway in genetic migration and reassortment of influenza virus” N 17-44-07001.

BIODIVERSITY OF MARINE FUNGI OF THE SOUTH CHINA SEA

Ekaterina EFIMOVA^{1,2}, Olga V. NESTEROVA¹

¹ Department of Soil Science, Far Eastern Federal University, Vladivostok, Russia

² Pacific Institute of Bioorganic Chemistry, FEB RAS, Vladivostok, Russia

J. Kohlmeyer described micromycete species of tropical waters had a great influence on the study of micromycetes of the South China Sea. The focus was on studies of mangrove forests.

A number of researchers have studied the mangrove forests of Brunei with different mycocenoses: *Bialriosfiora marina*, *Caryospora rhizophorae* colonize the dead roots and branches of mangrove trees, whereas *Lindra marinera* are found mainly on the leaves of *Thalassia sp.*

Hyde & Jones showed that fungal communities differ for one substrate to another depending on the beach and have extended knowledge of the geographical distribution of species described for the first time not long before this study: *Biconiospora corniculata* and *Carbosphaerella leptosphaerioides* were previously found only in temperate waters, but were found in the tropics for the first time. *Caryospora rhizophorae*, previously described in mangroves in Belize, was later found in the Indian Ocean, and now here in the South China Sea. *Diajmella* was found in the mangroves of India but was also collected in mangrove thickets of Brunei.

The aim of the research studies of marine fungi in Thailand was to determine the biodiversity of Thailand's marine fungi. The main result is that *Ascomycota* is the most common group of fungi with 116 species, and this correlates with the observations of other researchers. For the first time, the fungi *Astrosphaeriella mangovis*, *K. tethys*, *Savoryella paucispora* were identified in the mangrove *Nypa fruticans*.

The studies of the territory of Malaysia were also focused on the mangrove fungi: 32 species recorded in Singapore, 82 species listed 41. During the 25 years studies, about 300 marine fungi from the Malaysian mangrove have been recorded.

Similar data collected in the Philippines: it was discovered that the fungi isolated in the waters of the Manila Bay belong to the *Ascomycota* and *Zygomycota* groups. *Aspergillus sp.* was the dominant species, as in the previous study of the port of Manila. There are also a few studies of Taiwan: registered 59 species of marine fungi, 33 of which were isolated from mangrove forests. *Halophitophthora epistomium*, a permanent inhabitant of mangrove forests, was first recorded in Tung-hsin. Later, *Halophitophthora kandeliae* and *Halophitophthora elongate*. Fungal complexes of aquapods and hydrobionts (sea grasses, algae, soft corals) were studied in the area of the South China Sea for the first time. Twenty six species of fungi from 14 genera were first isolated from the soft corals of the genus

Palythoa. Data analysis of the marine plant's mycobiota showed that the species richness of micromycetes in the tropical and subtropical zones is 2–3 times lower than the species richness of the fungi of marine plants in the temperate zone. A higher concentration of dematiaceous fungi was detected in aquaplants of the subtropical zone. At present, the research of secondary marine fungi associated with marine autotrophic communities is being actively carried out. A variety of fungi of brown algae of the genus *Sargassum* was described (*S. pallidum*, *S. miyabei*), including a total of 29 species of fungi from 11 genera; 28 species of mycelial fungi from 9 genera were isolated from the sea grass of *Zostera marina*, and their zonal distribution in the biotic environment of sea grass was studied. The variety of isolated micromycetes is represented mainly by cosmopolitan species belonging to the group of anamorphic fungi. The taxonomic analysis of secondary marine fungi associated with marine plants revealed the predominance of species from the genera *Penicillium* and *Trichoderma*, the presence of *Cladosporium* species, *Aspergillus*, *Paradendryphiella*, and others.

MCOD: MUSHROOM CROP OMICS DATABASE

Yong Ping FU

Jilin Agricultural University, China

MCOD is a new online database containing genome, transcriptome and resequencing data for commercially cultivated edible mushrooms worldwide. MCOD consists of multi-omics data of 51 species, including 35 and 540 newly de novo sequenced and resequenced genomes data, respectively. These species represent 2 division, 4 classes, 9 orders, 24 families, and 30 genera from the kingdom Fungi. The home page offers BLAST search to compare genes across all species and in their own sequences. Specifically, we integrated multi-omics data for each species with the interactive visualization platform to help the user to easily and quickly find gene sequence, structure, expression and variation information. Thus, MCOD is an outstanding resource for a wide range of researchers to precisely predict the candidate functional genes using the integrated information of mushroom crops.

GENUS *RINODINA* OF THE KURIL ISLANDS

Irina A. GALANINA¹, Alexander K. EZHKIN²

¹ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

² Institute of Marine Geology and Geophysics, FEB RAS, Yuzhno-Sakhalinsk, Russia.

The genus *Rinodina* is considered as unique so it reflects specifics of a lichen biota of Northeast Asia. At its recent studying in the territory (Shaerd et al., 2017) the close relationships with the North America lichen biota have been revealed. Herewith many *Rinodina* species previously considered as endemic for North America have been found in Northeast Asia.

The genus *Rinodina* in the lichen biota of the Kuril Islands is still remaining unstudied. The presented work is based on study of the extensive material collected by the second author in the period from 2012 to 2017 from different islands of the Kuril archipelago (Kunashir, Iturup, Shikotan and Paramushir). As a result the list of *Rinodina* species for Kuriles counts 18 taxa; among them 1 new to Northeast Asia and to Russia, 16 new to Kuriles. Five species from the genus *Rinodina* (Bredkina et al., 1992; Chabanenko, 1999) were cited earlier for the Kuril Islands (Kunashir Island). They are *Rinodina archaea* (Ach.) Arnold, *R. gennarii* Bagl., *R. pyrina* (Ach.) Arnold, *R. sophodes* (Ach.) A. Massal., *R. xanthophaea* Nyl. Earlier, as a result of the study of the genus *Rinodina* in Northeast Asia (Sheard et al., 2017), we indicated that these species, with the exception of *R. gennarii* in the Russian Far East, were not found and were probably mislead in the literature. After the revision of the genus in the Kuril Islands, we also believe that these species are mistaken for the islands. *R. gennarii* was not found by us, but there is a possibility of its being found in coastal rocky habitats.

The Kuril Islands located in the northeastern part of the Pacific Ocean. The climate is temperate, monsoon type with a cold winter, but milder than in the continental part and with a cool rainy summer. The southern Kuril Islands (Kunashir, Iturup, Shikotan) is part of the Sakhalin–Hokkaido province of the East Asian floristic region (Takhtadzhyan 1978). The flora of northern Kuriles (Paramushir) is a significantly enriched with arctalpine elements including American flora representatives (Barkalov 2002).

The first lichenological investigations on Kuriles were performed by Japanese specialists in the beginning of the twentieth century. The first list of lichens numbered only 44 species Kuriles (Sato 1936). In 2002 the list of lichens included 260 species for Kuriles (Tchabanenko 2002), so this list additions of new records are found in several publications (Insarov & Pchelkin 1984; Tchabanenko 1999; 2004; Joneson & al. 2004; Makryi et al. 2010; Ezhkin 2016; Ezhkin & Kordyukov 2016). As for genus *Rinodina* only five species were previously registered for Kuriles (Tchabanenko 2002).

The specific structure of the genus *Rinodina* reflects a variety of ways of his formation. The genus *Rinodina* is for 28 % presented here by disjunctive species

with a distribution in the south of Russian Far East and western or east parts of North America. For example: *R. ascociscana* (Tuck.) Tuck., *R. megistospora*, *R. willeyi*.

The major part of these species were considered as endemic for North America until recently. It is mainly group of epiphyte lichens. Species of such distribution accurately are divided into two groups: East Asian – West North American and East Asian – East North American.

East Asian species number 22 % of the known number emphasizes the specificity of the genus structure of species found on Kuriles. Other species are widespread in both hemispheres or widespread circumpolar in a temperate zone of Holarctic (39 %). Concerning one of the main feature of the genus – type of spores – the most extensive group of species in the south of the Russian Far East with *Physcia* type of spores (9) and also with *Pachysporaria* type of spores (6). Study of the genus *Rinodina* in the Far East is continued. We express a great gratitude for assistance to Dr. J. W. Sheard the monographer of the genus *Rinodina*.

The work is partially supported by RFBR grants: 18-04-00098 A «Identification and assessment of the status of relict broad-leaved forests of the islands of the Russian Far East (Sakhalin and the Kuril Islands)», 15-29-02382 «Mycobiota of the Far East of Russia: revision of biological diversity as a unique component of northeast Asia».

RARE SPECIES OF VASCULAR PLANTS AND FUNGI IN THE UDEGE LEGEND NATIONAL PARK

Galina A. GLADKOVA, Lidiya A. SIBIRINA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Udege legend National Park (NP) has been created in 2007 for preservation of the natural complexes and standard natural sites located in the rivers valleys of the western macroslope of the Middle Sikhote-Alin in Krasnoarmeisky district of Primorye Territory. The main forest formations in this territory are the Korean pine broad-leaved, fir–spruce and elm–ashen forests which distribution is defined by zonal and altitude-belt factors. Characteristic feature of NP territory is wide distribution of the relic species which are a part of rare and unique forest communities (Krestov, 1993; Sibirina et al., 2015). Since 2013 the inventory of the NP forests by scientists of Institute of Biology and Soil Science (IBSS) FEB RAS (now Federal Scientific Center of the East Asia Terrestrial Biodiversity FEB RAS) was begun. On-site investigations took place in the basin of the Bolshaya Ussurka River and its tributaries – Armu and Lesovoznaya in virgin and undisturbed forests. Works were carried out by a detailed route method with establishment of sample plots in the most interesting and rare forest types. According to the cadastral information (Kadastrovaja informacija, 2009–2012), the rare vascular plants (*Coniogramme intermedia*, *Taxus cuspidata*, *Cypripedium calceolus*, *C. guttatum*, *C. macranthon*, *Paeonia lactiflora*, *P. obovata*, *Bergenia pacifica*) and fungi (*Leccinum extremorientale*, *Sarcoscypha coccinea*, *Hericium coralloides*), included in The Red data book of Primorye Territory (2008), are grown in the territory of NP. In addition to this list we for the first time have found *Phyllitis japonica*, *Liparis japonica*, *Cephalanthera longibracteata*, *Cypripedium ventricosum*, *Galium paradoxum*, *Iris ensata*, *Ganoderma lucidum*, *Hericium erinaceus* in the territory of NP. These finds added data on distribution of protected species in the Primorye Territory. Also 8 woody species, including to The IUCN Red List of Threatened Species (*Abies nephrolepis*, *Betula costata*, *Chosenia arbutifolia*, *Maackia amurensis*, *Picea koraiensis*, *Picea jezoensis* = *P. ajanensis*, *Pinus koraiensis*, *Taxus cuspidate*), is provided (The IUCN Red List).

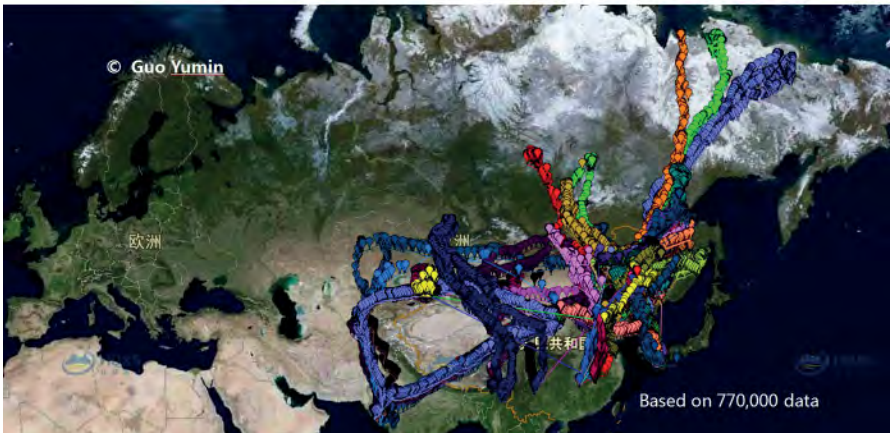
RESEARCH ON CRANE MIGRATION IN ASIA BASED ON GPS-GSM TRACKING

Yumin GUO

College of Nature Conservation, Beijing Forestry University, Beijing, China

Since 2014, we began research on crane migration based on GPS–GSM tracking. Seven of the 9 Asian crane species were tracked by us intensely. By now, a total of 130 individuals were followed over the years, and more than 770 000 GPS locations were received for analysis. The data reveal new and different routes of crane migrations in Asia. For instance, Demoiselle Cranes were documented to migrate along a loop route across the Tibetan Plateau, and the Hooded Crane migrates along an “X”-shaped route around the Yellow Sea. We found that the Siberian Crane migrates between two points, that the route is shaped like a ‘dumbbell’. Instead, the Black-necked Crane and Common Crane migration routes are similar to each other and have parallel lines etc. Our results show that the migratory impulses of cranes are inherent in the species, but that the actual choice of migratory route is learned.

The migration map of Cranes based on 770 000 data



**GENETIC DIVERSITY AND FORMATION HISTORY OF
PERIPHERAL POPULATIONS OF TWO BROAD-ARAIAL SPECIES:
BROWN BEAR *URSUS ARCTOS* LINNAEUS, 1758 AND
ASIAN BLACK BEAR *URSUS THIBETANUS* G. CUVIER, 1823**

Valentin Yu. GUSKOV

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Studying the historical mechanisms of the evolutionary processes in past is one of the fundamental tasks of biology. In this case, isolated and peripheral populations of wide-araial species are of considerable interest. Theoretically, in such populations, a decrease in genetic diversity should be expected compared to the central populations of the species (Lesica, Allendorf, 1995; Cassel, Tammaru, 2002; Eckert et al., 2008). As a rule, central populations are characterized by a higher population size and homogeneous distribution and occupy favorable habitats, while the individuals of marginal populations can be isolated from the main range of the species and fragmented, since it exists in a more volatile environment (Lesica, Allendorf, 1995). Geographical or ecological isolation and differing environmental conditions can facilitate the rapid divergence of marginal populations and the consolidation of rare haplotypes as a result of gene drift and/or natural selection (MacArthur, Wilson, 1967; Garcia-Ramos, Kirkpatrick, 1997) or lead to their death as a result of the same processes (Cassel, Tammaru, 2002). In turn, men became a “catalyst” of the process of extinction of species or individual genetic lines, increasing the speed of these processes hundreds of times. In this regard, the study of peripheral (marginal) and isolated populations is an important aspect for the analysis of the structure of the species as a whole, as well as for creating standards for preserving diversity.

As objects of the study, we used peripheral populations of two broad-mountainous species of large mammals: the brown bear *Ursus arctos* Linnaeus, 1758 and Asian black bear *Ursus thibetanus* G. Cuvier, 1823, from the territory of the south of the Far East of Russia. As markers, we used sequences of the cytochrome *b* gene and the mitochondrial DNA control region obtained during this work, as well as homologous sequences of the mitochondrial genome from the GenBank/NCBI database.

One of the interesting features of Russian Far East south is that: this area was never covered by an ice sheet (Lattin, 1957). Accordingly, here could remain samples of the genetic diversity of both populations of bears. Earlier, for the brown bear, we received preliminary data (Guskov et al., 2013; Guskov, 2014), according to which in Primorsky Krai we were found ancient haplotypes, unlike haplotypes, widespread everywhere. We don't know what picture we have for the Asian black bear, as studies for this territory are not enough for such conclusions. Analysis of the distribution of genetic lines across the species range is an important tool for

studying the diversity and reconstruction of ways to distribute species in the past (Avice, 1987, 2000; Abramson, 2007, 2009; Kholodova, 2009; Townsend et al., 2011; Kinoshita et al., 2015). In this paper, we plan to fill the missing fragments of history of both bear species, and also to detail the hypotheses about the distribution of these species on the territory of the Russian Far East south.

LONG-TERM CHANGES IN AUTUMN MIGRATION PHENOLOGY OF BACKGROUND BUNTING SPECIES BASED ON BANDING DATA IN THE VALLEY OF LITOVKA RIVER (SOUTH OF PRIMORYE)

Denis IRINYAKOV^{1,3}, Olga P. VALCHUK^{1,2}, Konstantin S. MASLOVSKY^{1,2},
E. LELIYCHINA³, S. YUASA⁴, K. MAMIYA⁴

¹ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

² NPO Amur-Ussuri Centre for Avian Biodiversity, Vladivostok, Russia

³ Far Eastern Federal University, Vladivostok, Russia

⁴ Prefectural Branch Japanese Society for Preservation of Birds, Toyama, Japan

The seasonal phenology of cycle movements is one of the key life-cycle traits of migratory birds. For example, the dynamics of numbers for many species during seasonal migration could be correlated with the next season's survival rate, and with long-term trends of population dynamics.

Long-term changes of numbers estimated for 5 background buntings during 18 years (1999–2016) based on banding data in the valley of Litovka river at the "Primabirds" banding station (South–East Primorye, Russia). Our study species included 3 resident (breeding) migrants: Black-faced bunting (*Ocyris spodocephalus*/BB), Yellow-throated bunting (*Cristemmeriza elegans*/YB), and Tristram's bunting (*Ocyris tristrami*/TB); and 2 long-distance (non-breeding) migrants: Chestnut bunting (*Ocyris rutilus*/CB) and Rustic bunting (*Ocyris rusticus*/RB). We used data on primary catch to exclude individuals that could be at the migratory stopover site.

Timing of autumn migration was determined by the interval between first and last capture of species at the banding station for long-distance migrants. We also assumed that date of migration start for resident species was determined by the increase of frequency in encounters in capture/day ($v > 80\%$ per 5 days), and end date of migration was determined as the day of last capture. We excluded late meetings of RB and YB from our calculations because they were reported even in winter. Therefore, for RB the average of autumn migration timing is between $28 \pm 1,7$ (Sep.) – $27 \pm 1,02$ (Oct.), CB: 25 (Aug.) – $11 \pm 1,3$ (Oct.), TB: $7 \pm 3,2$ (Sep.) – $11 \pm 1,2$ (Oct.), BB: $10 \pm 2,8$ (Sep.) – $18 \pm 1,1$ (Oct.), YB: $19 \pm 3,1$ (Sep.) – $24 \pm 5,7$ (Oct.). Total autumn migration timing is between 25 Aug. and 29 Oct. for our study species.

We investigated dynamics of total abundance for 5 species and did not find the cyclicity (autocorrelation decreases sinusoidal attr.). In addition, linear trend of total number demonstrated decline with the rate of 4,34 % per year. Consequently, the number of buntings evenly fills the environment capacity in our study area during autumn migration, and it's not described by any explicit long-term cycles of the environment. At the same time, the hypothetical capacity is reduced.

We used quantile regression to model long-term changes in autumn migration timing. We separated the relative daily number on 0.10, 0.25, 0.50, 0.75, and 0.90 quantiles to evaluate long-term changes. We calculated the difference in number

of days between the 0.10 and 0.90 quantiles for 1999 and 2016 as the 2 endpoints.

We obtained that median timing of autumn migration for CB declined with rate 0.29 days per year (-5.3 days per total time); for RB – 0.06 days per year (-1,1). We assumed that this phenomenon is associated with the total decline in the number of this species. Long-term change for other species that combine transit and resident individuals was increased for 2.7 ± 0.5 during the whole study period.

This finding may be a signal of changes in the influence of exogenous or endogenous factors of population regulation which are important to study dynamics of biodiversity of migratory birds. In the future we will continue to study the phenology of bird migration and the factors that affect its changes.

TAXONOMIC AND ECOLOGICAL DIVERSITY OF *PUCCINIA* SPECIES ON GRAMINEAE AND CYPERACEAE IN JILIN, CHINA, CLARIFIED WITH MORPHOLOGICAL AND MOLECULAR ANALYSES

Jing-Xin JI¹, Zhuang LI², Yu LI¹, Makoto KAKISHIMA^{1,3}

¹Engineering Research Center of Chinese Ministry of Education for Edible and Medicinal Fungi, Jilin Agricultural University, Changchun, Jilin, China

²College of Plant Pathology, Shandong Agricultural University, Tai'an, China

³University of Tsukuba, Tsukuba, Ibaraki, Japan

Jilin Province is located in the northeast of China and geographically divided into three main areas: an eastern mountainous area, a western dry plain area and the rolling hilly area between them. The natural vegetation consists of prairie grasses in the western plains and broad-leaved deciduous forests mainly consisting of species of *Betula*, *Populus* and *Quercus* in the hilly and mountainous areas. These areas are rich in vegetation and other suitable environmental conditions to predict a proliferation of rust fungi, especially in the Changbai mountain ranges located at the border of North Korea that harbor conserved natural forests. However, the inventory and ecology of rust fungi have not been sufficiently investigated in Jilin Province. Therefore, we surveyed rust fungi in several locations in Jilin Province from 2013 to 2017 and collected about 1000 specimens. Among them, about 300 specimens were *Puccinia* species on Gramineae and Cyperaceae which were dominantly growing in Jilin Province. We also collected about 50 specimens which are hypothesized to represent the spermogonial and aecial stages of these *Puccinia* species. However, identifications of these specimens are very difficult because of morphological similarity among specimens and difficulties of host identification. Although many are suspected to be heteromacrocytic species the connections among different stages (spermogonial, aecial, uredinial and telial stages) cannot be confirmed because of difficulties of inoculation experiments and also difficulties of obtaining plants from conservation areas. For resolving these problems molecular analyses were applied. ITS and 28S regions of rDNA from specimens were amplified and sequenced. After constructing phylogenetic trees by the ML and BS methods about 35 clades were detected. These clades were suspected as species based on morphological observations and host relations. Species of these clades were identified and life cycle connections among stages were clarified based on the species reported in China although many cryptic species were found among these clades.

CIRCUMPOLAR MACROFUNGI OF ALPINE AND SUBALPINE FORESTS IN JAPAN

Taiga KASUYA¹, Ei KAWAHARA², Yoshito SHIMONO³, Kentaro HOSAKA⁴

¹ Chiba Institute of Science, Japan

² Kanazawa University, Japan

³ Mie University, Japan

⁴ National Museum of Nature and Science, Japan

Most of Japan lies in the temperate zone, but a number of alpine and subalpine zones are studied in the vicinity of mountain peaks in the central and northern regions. These alpine zones are characterized by timber-limited areas, together with forests of dwarf pine, *Pinus pumila* (Pall.) Regel. The alpine flora in Japan, which is composed of distinct species from subalpine flora, has been well-studied and many are considered to be legacy species of those that had migrated southward to Japan through the Kuril Islands or Sakhalin from the circumpolar subarctic belt during the glacial periods in the Pleistocene epoch. Molecular phylogeographic studies in addition to fossil records have confirmed that some plants and animals survived in glacial refugia during inter- and post-glacial periods in Europe and America. In contrast, the diversity of circumpolar macrofungi in Japan has been little studied, with a few exceptions such as *Collybia cirrata* (Schumach.) Quél., *Inocybe decipiens* Bres., *Lycoperdon ericaeum* Bonord., *L. nigrescens* Pers., *Russula decolorans* (Fr.) Fr. and *R. paludosa* Britzelm. The main reasons for this are the difficulty of access due to the high altitude and the fact that special permission from the government is required to collect samples in these legally protected zones. Nevertheless, Ishikawa Mycology Association has been investigating the mycobiota in the alpine and subalpine zones of Mt. Hakusan, the Japanese westernmost limit of the distribution of *P. pumila*, since 1989, under the aegis of the Ministry of the Environment. Previously, ca. 80 species of macrofungi have been recorded in the alpine and subalpine zones of Mt. Hakusan. Recently, we have carried out DNA sequencing and phylogeographic analyses of several macrofungal specimens collected in the alpine and subalpine zones of Mt. Hakusan. Among them, several species of Russulaceae such as *R. decolorans*, *R. paludosa*, *Lactarius chrysorrheus* Fr. and *Lac. fallax* A.H. Sm. & Hesler found in *P. pumila* forests were identified to the same species as those in European and North American subarctic and subalpine zones. These Russulaceae species are considered as ectomycorrhizal symbionts with *P. pumila*, and presumably they had migrated southward to Japan from the circumpolar subarctic regions of the Northern Hemisphere through Kuril Islands or Sakhalin with *P. pumila*. Therefore, *P. pumila* forests in the alpine zone of Mt. Hakusan play an important role as glacial refugia during inter- and post-glacial periods for circumpolar ectomycorrhizal macrofungi.

THE DIVERSITY OF VALUABLE STILBENES IN THE RUSSIAN FAR EAST FLORA

Konstantin V. KISELEV^{1,2}, Aleksandra S. DUBROVINA¹, Olga A. ALEYSNOVA¹,
Andrey R. SUPRUN^{1,2}, Zlata V. OGNEVA¹,

¹ *Laboratory of Biotechnology, Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia*

² *Far Eastern Federal University, Department of Biodiversity, Vladivostok, Russia*

Stilbenes, including the most-studied stilbene resveratrol, are a family of phenolic plant secondary metabolites that have been the subject of intensive research due to their valuable pharmaceutical effects and contribution to plant disease resistance. In the Russian Far East flora, there are several plant species producing high levels of stilbenes. We described the content and spectrum of stilbenes accumulating in spruce *Picea jezoensis* (Lindl. et Gord.) Fisch ex Carr. and grapevine *Vitis amurensis* Rupr. We showed seasonal variation in stilbene content and expression of the stilbene synthase genes. According to the data obtained, several treatments (ultraviolet irradiation and feeding with plant phenolic precursors) led to a significant increase in stilbene content in spruce needles and grapevine leaves.

MODERN CONIFEROUS SPECIES DIVERSITY ON ISLANDS OF PRIMORSKII KRAI

Alyona G. KISELYOVA

Pacific Geographical Institute, FEB RAS, Vladivostok, Russia

The islands of Primorskii Krai are in coniferous-broad-leaved forest zone and can be considered as local centres of diversity conservation for coniferous species. Most of the islands are in the southern part of the region in the Peter the Great Bay (the Sea of Japan). At present, natural coniferous communities on the study islands are rare, the dominants are polydominant broad-leaved forests. It is connected with active economic activity on the islands since the middle of the XIX century. Biomorphs of coniferous species on the islands of Primorskii Krai are shale, shrub and wood. At present, islands are subject to intense anthropogenic impact and need environmental protection efforts. The research was conducted in 2004–2017. The current state of vegetation was estimated on the basis of geobotanical descriptions of vascular plant communities, distribution, frequency of occurrence (abundant 60–100 %, frequent 40–60 %, common 20–40 %, rare 5–20 %, very rare – less than 5 %, single – less than 1 %). The list of conifers includes 8 species that were found on 27 islands: *Abies holophylla* Maxim., *Abies nephrolepsis* (Trautv.) Maxim., *Picea ajanensis* (Lindl. Et Gord.) Fisch. ex Carr., *Pinus densiflora* Siebold et Zucc., *Pinus koraiensis* Siebold et Zucc., *Juniperus davurica* Pall., *Juniperus rigida* Siebold et Zucc., *Taxus cuspidata* Siebold et Zucc. ex Endl. The largest number of coniferous species is represented on Petrova Island: *Abies nephrolepsis*, *Picea ajanensis*, *Pinus koraiensis*, *Juniperus davurica*, *Juniperus rigida*, *Taxus cuspidata*; three species grow on Popova Island: *Abies holophylla*, *Pinus koraiensis*, *Taxus cuspidata*, *Pinus koraiensis*, *Juniperus davurica*, *Juniperus rigida* are on Skala Kreiser Island; two species are found on Stenina Island, Bolshoi Pelis Island and De-Livrona Island maintain *Abies holophylla*, *Taxus cuspidata*, *Abies holophylla*, *Pinus densiflora* are on Shkota Island, *Abies holophylla*, *Pinus koraiensis* grow on Rikorda Island, Orekhova Island keep *Pinus koraiensis*, *Taxus cuspidata*, Beltsova Island maintain *Juniperus davurica* and *Taxus cuspidata*. The remaining islands have one coniferous species at an island. Coniferous plantations perform the environment-forming, protective, recreation and other roles. Analysis of the distribution of coniferous species on the islands of Primorskii Krai confirms the need to assess the state of island territories, their importance for the conservation of coniferous communities. The Naumova and Petrova Islands act as the leading centres for the conservation of *Taxus cuspidata* populations. There are communities of the *Pinus densiflora* on the Vkodnii islands. Large plantations of *Abies holophylla* on Russkii Island are represented by artificial plantations, while the plantations of Stenina Island have natural origin. The islands of Skali Kreiser islands are dominated by the stunted communities of *Juniperus davurica*. Three of eight coniferous species

found on the islands are protected species that are included in the Red Data Book of Russian Federation and Red Data Book of Primorye Territory – *Pinus densiflora*, *Juniperus rigida* and *Taxus cuspidata*. The most common species on the islands is *Taxus cuspidata*.

**RELATION OF NATURAL WATERS CHEMICAL COMPOSITION TO
THE SIKHOTE-ALIN FOREST ECOSYSTEMS DIVERSITY**

Nadezhda K. KOZHEVNIKOVA¹, Maksim L. BURDUKOVSKII¹,
Polina A. PEREPELKINA¹, Tatiana N. LUTSENKO², Sergey Yu. LUPAKOV²,
Vladimir V. SHAMOV²

¹ *Federal Scientific Center of the East Asia Terrestrial Biodiversity FEB RAS, Vladivostok, Russia*

² *Pacific Geographical Institute, FEB RAS, Vladivostok, Russia*

On the basis of field measurements in mountain forest river basins, the original data on the components of the water and biogeochemical cycles were obtained. The quantitative estimation of spatial and temporal variability of dissolved substances intake and migration is given, and the degree of the forest type influence on the variability in natural water chemical composition is determined. Diagnostic signs of nutrients accumulation under the canopy have been established. Detailed surveys have made it possible to identify the habitats with increased organic carbon, nitrate nitrogen and sulfates soluble forms in water of different origin.

INSECT BIODIVERSITY OF THE NORTH PACIFIC AREA

Arkady S. LELEJ, Sergey Yu. STOROZHENKO

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

The problem of biodiversity of the World and its regions is widely discussed now. Among 1,6 millions described living organisms in the World the insects are most numerous (950,000 species, or 60 %).

Three regions in North Pacific Area (Russian Far East, Japan and Canada) have almost the same number of species (about 30 thousand). Russian Far East and Canada belong to the temperate zone of Holarctic. Southern borders of these vast regions have the same latitude (42° N), which result in similarity of climatic and vegetation belts. These factors have strong influence for distribution and diversity of insects. Therefore total number of insect species in both regions is almost equal, and percentages of Lepidoptera (16 % of total species) and Diptera (24–25 %) are the same, but Coleoptera and Orthoptera are more numerous in Canada. The number of recorded insect species for Japan is approximately the same as for Russian Far East and Canada. The reason of such similarity, in spite of quite different square, depends on more southern position of Japan (up to 23' N). Coleoptera is represented in Japanese fauna much better (32 % of total insect species) than in Canada (25 %) or Russian Far East (17 %), probably it results of the increasing of beetle percentage for subtropical faunas.

Russian Far East occupies an area of 3016 thousand sq. km. and extends from Wrangel II. (71° N) southwards to Khasan Lake (42° N) and from Dezhnev Cape (170° W) westwards to Stanovoj Range (120° E). The insect fauna of the Russian Far East is represented by about 31500 estimated species from 629 recorded families of 31 orders. The largest orders are Hymenoptera (69 families, 7503 recorded species), Diptera (119 families, 8000 estimated species), Coleoptera (114 families, 5500 estimated species), Lepidoptera (85 families, 4871 recorded species). The most insect orders are well represented in each region except Chukotka. There are four levels of insect family diversity: around 200 families (Chukotka), around 300 (Magadan Region and Kamchatka Territory), around 450 (Amur Region, southern part of Khabarovsk Territory, Sakhalin and Kuril Islands), and 600 families (Primorye Territory). The species richness depends on the zonal landscapes: (1) the zonal and mountain tundras of Chukotka (1100 species), Magadan Region (4200) and Kamchatka (3700), (2) the taiga landscapes of Khabarovsk Territory (11000) and Amur Region (10700), (3) the nemoral cenoses of Primorye Territory (22600), (4) the island cenoses of Sakhalin (7800) and Kuril Islands (8000 species).

The mountain areas in the North Pacific are the refugia of the Mesozoic and Tertiary insect faunas. The Pacific may have substantially reduced the Cenozoic aridization in the northern hemisphere, which was one of the important factors of formation of the recent biota in the Palaearctic and Nearctic regions.

BIODIVERSITY OF DICTYOSTELIDS IN HIGH-ELEVATION HABITATS ON THE QINGHAI-TIBET PLATEAU, CHINA

Pu LIU, Yue ZOU, Qi WANG, Yu LI

Engineering Research Center of Chinese Ministry of Education for Edible and Medicinal Fungi, Jilin Agricultural University, Changchun 130118, P. R. China

Dictyostelid cellular slime molds (dictyostelids) are the second largest group of slime molds. Members of the group live in the soil and feed upon bacteria and other microbes. The Qinghai-Tibet Plateau, which is the highest plateau in the world, is characterized by unique and important forest types because of the considerable range in elevation which exists. Studies of dictyostelids in this region are exceedingly limited and consist of a single previous report of a species new to science. During the period of 2012, 2013 and 2016, samples of soil and animal dung for the isolation of dictyostelids were collected on the Qinghai-Tibet Plateau. These samples yielded 12 species of dictyostelids, including two new species (*Dictyostelium minimum* Li Y., P. Liu et Y. Zou, and *D. multiforme* Li Y., P. Liu et Y. Zou). Three species (*D. brevicaule* var. *brevicaule*, *D. vermiformum*, and *Hagiwaraea fasciculata*) were new records for China. Six other species (*D. brefeldianum*, *D. crassicaule*, *H. antarctica*, *H. aureostipes*, *H. exigua*, and *Heterostelium tikalense*) were new records for the Qinghai-Tibet Plateau. Within China, *H. exigua* had been reported previously only from Taiwan, *H. antarctica* from Hubei Province, *H. aureostipes* from Liaoning Province, *D. crassicaule* from Guizhou Province, and *H. tikalense* from Jilin Province. *Dictyostelium brefeldianum* had been reported from the Jilin, Fujian, and Taiwan provinces prior to the present study, and *D. sphaerocephalum* had been reported previously from the Heilongjiang, Tibet, Henan and Hainan provinces. Observations of the life cycle and ultrastructure of the new species *D. minimum* and *D. multiforme* confirm that they are new species and the surface of their spores has a distinctive ornamentation. The completion of the entire life cycle of *D. minimum* and *D. multiforme* requires 56 h and 41 h, respectively. Phylogenetic studies of both new species, based on ITS and SSU, indicate that *D. minimum* and *D. multiforme* are members of Group 4B-D. In the SSU phylogenetic tree generated in the present study, *Synstelium* was assigned to the clade Acytosteliaceae in the Acytosteliales. To our knowledge, the study reported herein is the first investigation of dictyostelid biodiversity carried out at elevations between 2000 m to 5000 m. Sorocarp size, sorus size, spore length, ratio of sorus and sorophore, and ratio of sorus and spore size were positively correlated with increasing elevation, according to the results of linear regression analysis.

This study was supported by the National Key Technologies R & D Program (No. 2012BAC01B04), the Program of Creation and Utilization of Germplasm of Mushroom Crop of "111" Project (No. D17014), the National Natural Science Foundation of China (No. 31300016, 31093440, 31493010 and 31493011).

MAPPING ASIA PLANTS: INITIATIVE AND PROGRESS

Keping MA^{1,2}, Xuehong XU^{1,2}, Maofang LUO^{1,2}, Bo LIU¹, Hongfeng WANG¹,
Jianhua XUE¹, Qinwen LIN¹, Wenjun LI³

¹ *Institute of Botany, Chinese Academy of Sciences, China*

² *Biodiversity Committee, Chinese Academy of Sciences, China*

³ *Xiangjiang Institute of Ecology and Geography, Chinese Academy of Sciences, China*

Because of the huge population and rapid growth of economy, biodiversity including plants are being seriously threatened in Asia. Researches on conservation and sustainable use of biodiversity are depended on species cataloging and monitoring to a great extent. But till now, there is no biodiversity database infrastructure in regional scale in Asia, while there are certain independent efforts of Biodiversity database construction in China Mainland and China Taiwan, India, Japan and Korea, which has serious impacts on biodiversity research and protection at regional scale in Asia.

Thus, Mapping Asia Plants (MAP) was initiated at the meeting of ABCDNet (ABCDNet, www.abcdn.org) working group on Nov., 2015, and was funded by Bureau of International Co-operation and Southeast Asia Biodiversity Research Institute Chinese Academy of Sciences.

MAP provides a database and standardized workflow for mapping Asia plant species, distribution, and is available to comprehensive basic information and interdisciplinary data mining for plant diversity conservation and research. MAP aims to collect, integrate Asia plant diversity resources and to construct a platform of Asia plant diversity.

Major achievements so far are as follows. Species checklist databases have been basically set up in five sub-regions of Asia (Southeast Asia, South Asia, Northeast Asia, North Asia and Middle Asia) to the national level, and the species checklist databases have been basically set up in 3 countries in West Asia.

1) for Southeast Asia, a dataset of 425 families, 4873 genus, 69291 species has been set up; 2) for South Asia, a dataset of 325 families, 3817 genus, 32525 species has been set up; 3) for Middle Asia, a dataset of 169 families, 1404 genus, 9047 species has been set up; 4) for Northeast Asia, a dataset of 417 families, 4345 genus, 42566 species has been set up; 5) for North Asia, a dataset of 191 families, 1187 genus, 7700 species has been set up; 6) for West Asia, a dataset of 200 families, 2543 genus, 6000 species has been set up.

DIATOM DIVERSITY OF THE SOUTHERN PART OF THE RUSSIAN FAR EAST

Lyubov A. MEDVEDEVA, Tatiana V. NIKULINA

Federal Scientific Center of the East Asia Terrestrial Biodiversity FEB RAS, Vladivostok, Russia

The Russian part of the Far East has a well-developed and dense hydrographic network, and there are many rivers (mainly those belonging to the Amur River basin), lakes (the largest of which is Khanka), reservoirs, ponds and swamps in this area. The study of the species diversity of freshwater algae in the Far East began 100 years ago with the works of the famous Russian algologist Boris Vladimirovich Skvortzow (Skvortzow, 1917, 1918). Studies of the diatom flora have been carried out over the course of a century by many Russian scientists, and basic data on the diatom algae of the region are known from the papers of Russian algologists B.W. Skvortzow, I.A. Kisselew, A.P. Zhuze, A.G. Khakhina, V.V. Zhurkina, L.A. Kukharenko, L.A. Medvedeva, S.S. Barinova, and T.V. Nikulina. Currently, 1079 species (1408 intraspecies taxa) of diatom algae from three classes are known from the southern part of the Russian Far East (SPRFE).

The algal floras of the administrative subjects of the SPRFE (the Amur Region, the Jewish Autonomous Region, the Sakhalin Region, the Primorye Territory, and the southern half of the Khabarovsk Territory) are heterogeneous both in terms of the total species composition and in the number of species in the individual classes. The greatest species richness was noted for the algal flora of the Primorye Territory, 720 species (973 species, varieties and forms) of diatom algae were found in its water bodies and watercourses. For the Khabarovsk Territory and the Sakhalin Region, 678 (835) and 665 species (759), respectively, are indicated. The algal flora of the Amur Region is represented by 247 species (286), and 225 (268) are found in the Jewish Autonomous Region.

In the diatom flora of the SPRFE, class Bacillariophyceae is the most diverse; it contains 78.5% of the total number of diatom algae identified. The following families contain the largest number of species, varieties and forms: Naviculaceae – 142 species (162 intraspecific taxa), Bacillariaceae – 104 (132), Pinnulariaceae – 103 (140) and Cymbellaceae – 83 (96). In addition the genera *Pinnularia* – 101 species (138 species and forms), *Navicula* – 76 (100), *Nitzschia* – 67 (81), *Eunotia* – 61 (80), *Gomphonema* – 46 (63), *Cymbella* – 33 (43), and *Surirella* – 32 (56) species richness in the systematic structure of the algal flora.

The diatom flora of the SPRFE includes more than 100 of rare species. Some of them: *Actinella brasiliensis* Grunow, *Brebissonia lanceolata* (Agardh) Mahoney et Reimer, *Cymbella janischii* (Schmidt) De Toni, *C. mexicana* (Ehrenberg) Cleve, *C. peraspera* Krammer var. *gigantea* (Pantocsek) Krammer, *Encyonema muelleri* (Hustedt) Mann, *Eunotia diadema* Ehrenberg, *E. zygodon* Ehrenberg, *Stenopterobia capitata* (Fontell) Lange-Bertalot et Metzeltin, *S. sigmatella* (Gregory) Ross, *Surirella*

pantocsekii Meister, *S. tientsinensis* Skvortzow, *Ulnaria inaequalis* (H.Kobayasi) *M. Idej*, and others.

The combination and associations of data on the diatoms of the reservoirs of the continental and insular territories of the south of the Far East are important for determining the significance of the algal flora of the Far Eastern region on a global scale, subsequent comparative analyses using data from the algal flora of neighbouring regions, and the future biogeographic analysis of diatoms.

TOXOCARIASIS AMONG DOMESTIC DOGS IN VLADIVOSTOK: A LONGITUDINAL STUDY

Tatyana V. MOSKVINA¹, Elena N. LUBCHENKO², Tatyana F. HOMICHUK³,
Olga B. ROMANOVA³, Mikhail Yu. SHCHELKANOV^{1,4,5}

¹ Far Eastern Federal University, Vladivostok, Russia

² Regional State Budget Institution "Veterinary Anti-Epzootic Service in Primorye Territory",
Vladivostok, Russia

³ Federal Budget Institution of Health "Center for Hygiene and Epidemiology in
Primorye Territory", Vladivostok, Russia

⁴ Federal Scientific Center of East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

⁵ National Scientific Center of Marine Biology FEB RAS, Vladivostok, Russia

Toxocariasis caused by roundworm *Toxocara canis* is a major zoonotic disease with worldwide distribution. Dogs and other *Canidae* are the definitive hosts for *T. canis*, adult worms live in intestine; unembryonated eggs are passed with feces in environment and then third stage larvae within eggshell develop within three to six weeks under appropriate conditions such as warm temperature and high humidity. Puppies are frequently affected *T. canis* due to transmammmary and transplacental passage of *T. canis*. High prevalence also registers in free-roaming dogs, which have never received anthelmintic treatment. High worm burden leads to weight loss, vomiting, intestinal obstruction and mortality, especially in young animals.

Humans are the paratenic hosts for *T. canis*, where larvae migrate and encyst in different tissues and organs, caused the so-called larvae migrans syndrome. There are several types of toxocariasis distinguished in humans: ocular toxocariasis, common toxocariasis and neurotoxocariasis. Human can be infected by ingesting fruits and vegetables or soil contaminated by embryonated eggs. Due to the high prevalence rates of *T. canis* among humans and dogs population, it is necessary to investigate the spreading of *T. canis* in different regions and ecosystems in humans and dogs. Moreover, dogs feces contaminated by *T. canis* eggs are major source of environment contamination. The aim of this study is to investigate the prevalence of *T. canis* among dog population in Vladivostok and distinguished risk factors associated with *T. canis* infection.

Totally fecal samples from 782 dogs were investigated during 8 years period of the study (1992–1995, 2014–2017). Feces were examined using flotation method with saturated NaNO₃ and Zinc Sulfate solutions (specific gravity 1.2 g/l). Bivariate logistic regression analysis was used for estimation correlation between *T. canis* prevalence and factors such as dog age, breed, sex and season of the year.

T. canis eggs were found in 58 dogs. Puppies were formed the most part of infected dogs (67.2 %), the *T. canis* prevalence in young dogs (1–3-year-old) was 20.7 %; dogs elder than 3 years – 10.3 % among *Toxocara* positive dogs. There is no significant difference between *T. canis* prevalence in male and female dogs. Two types of mix-infections were registered including *T. canis* + *Uncinaria stenocephala*

(3.4 %), and *T. canis* + *Cystoisospora* spp. (10.3 %). The high prevalence of *T. canis* was registered in autumn (8.7 %) and summer (7.5 %) periods, the prevalence decreased in winter (7.1 %); the lowest prevalence were registered in spring (2.3 %). The bivariate logistic regression analyzes showed that the correlation between *T. canis* prevalence and dog age as well as between *T. canis* prevalence and breed was negative. The male dogs were in 6.1 times higher affected by *T. canis* than females. The significant correlation was found between the prevalence and autumn and winter.

Our data show significant association between *T. canis* infection and male gender, similar results were recorded in dogs population in Northern Greece and India. Contrary to other authors recorded high prevalence of *T. canis* in puppies and young dogs, the results of present study does not show significant correlation.

The study was supported by the Program of fundamental research of the Far Eastern Branch of the Russian Academy of Sciences «Far East» (2018–2020), project 18-5-060.

**RIBOTYPIC DIVERSITY AND STRUCTURAL FEATURES
OF THE INTERNAL TRANSCRIBED SPACER (ITS) FOR
REPRESENTATIVES OF THE GENUS *RHODIOLA* L.
(CRASSULACEAE)**

Vyacheslav Yu. NIKULIN, Artur Yu. NIKULIN, Valentina V. SHOKHRINA,
Andrey A. GONTCHAROV

Federal Scientific Center of East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Phylogenetic relationships in the taxonomically complex and morphologically polymorphic genus *Rhodiola* L. (Sempervivoideae, Crassulaceae) were analyzed using a large data set of 623 ITS rDNA sequences.

To identify positional homology between divergent sequences, secondary structure models were generated for each sequence by mfold web server (<http://mfold.rna.albany.edu>) and used to guide the alignment (Coleman, 2003, 2007, 2015; Gontcharova, Gontcharov, 2004; Caisova et al., 2013; Nikulin et al., 2015).

Models of the ITS1 and ITS2 rDNA secondary structure for *Rhodiola* taxa are generally consistent with those in other plant groups (Coleman, 2015) and were very similar to related Crassulacean genera (*Sedum* L. and *Orostachys* Fisch.; Nikulin et al., 2015; Nikulin et al., 2016). In both ITS1 and ITS2, the transcripts have four characteristic helical domains. The ITS2 model also revealed features typical for most eukaryotic organisms, namely four domain structures with the third hairpin loop domain being the longest, pyrimidine-pyrimidine mismatch at the base of helix II, and a UGGU site at the distal part of helix III (Schultz et al., 2005).

In our data set length of the ITS region (ITS1+5.8S+ITS2) varied from 538 to 636 bp and the average was 602.3±6.6 bp. The percentage of bases guanine+cytosine (hereafter GC) was in the range 52–55 % (mean 54.1±0.9 %). The length of ITS1 was 224±2 bp. The GC content was 55.6±1.6 %. Almost all sequences of the 5.8S exon in the data set were 161 bp long (GC from 51 % to 53 %). The mean length of ITS2 was 216±5 bp. Mean GC content was 53.8±1.2 %.

278 ITS ribotypes were revealed in the dataset. Interestingly, some ribotypes (13 examples) were shared by two and more species. In the same time, most (21) species were represented by more than one (2 to 22) ribotypes. For example, *R. integrifolia* Raf. most represented in the analysis (107 sequences) revealed 22 ribotypes that did not mix with representatives of other species. In most cases these ribotypes differed by substitutions and/or indels in single-stranded regions and hemi-compensatory substitutions. Only a few compensatory substitutions were revealed in the data set.

Thus, a large variety of ribotypes was found, which not always correlate with species identification. Information of the ITS secondary structure allowed to align the sequences in controversial sites for further phylogenetic analyzes.

This research was supported by the Russian Foundation for Basic Research grant (18-34-00436).

FOREST TYPOLOGICAL DIVERSITY OF THE PRIMORYE TERRITORY

Boris S. PETROPAVLOVSKY¹, Lyubov A. MAYOROVA²

¹*Botanical Garden-Institute, FEB RAS, Vladivostok, Russia*

²*Pacific Geographical Institute, FEB RAS, Vladivostok, Russia*

For the organization of the forest complex on the principles of sustainable and multi-purpose forest management, the development of the classification of forest ecosystems is topical. Despite the ample forest typological study of Primorsky Krai, there is still no single summary of forest types in this region. A diagram of the types of the Far East with a certain orientation to the edges and regions included in the region is available in the «Taxator's Handbook» (1955) and in a more extended version in the «Directory of the Forest Inventor of the Far East» (1973). Types of forests are of particular importance for the compilation of forest inventories, in many respects the natural and normative basis for the activities of the forest complex.

Of particular interest are data on the forest typological structure of the forest cover of Primorsky Krai, obtained with the help of accounting of all inventory materials of the leshozes of Primorsky Krai. Forest management fixes 140–150 types of forest, which are related to 23 formations and subformations. Forest types are grouped into 69 groups of types.

It is necessary to include in the subsequent editions of the «Directory of the forest inventory manager» in the forest type lists by regions, including Primorsky Krai, updating them with additional materials. It seems reasonable to take as a basis a summary of the forest formations of Primorye and Priamurye B.P. Kolesnikov (1956).

As a result of many years of research (Petropavlovsky, 2004, Mayorova, Petropavlovsky, 2017), the main core of the forest typological diversity of Primorsky Krai has been identified. Forestry and taxation characteristics of 100 forest types, most often used in forestry practice, in forest management and in other areas, are given. For 100 types of forest data on the occupied area are given, which made it possible to identify mass and rare types of forest. The tables of ecological conjugation and the computer map of distribution of the prevailing types of trees and forest types of Primorsky Krai have been compiled. These materials can be used for monitoring forests, compiling forest maps of any scale, reconstructing and reconstructing forest vegetation, creating a monograph on ecology and distribution, and a computer atlas of forest vegetation in Primorsky Krai.

Quantitative relationships between the leading factors of the environment and the typological structure of forest vegetation are revealed. It is established that the forests of the Primorsky Krai are actually ecotones of the planetary level, in connection with the fact that they are actual at the junction of the main types of vegetation – boreal (southern part of the range) and nemoral (northern part of the range). This causes a relatively low degree of ecological compatibility between these types of vegetation and zonal system-forming environmental factors that

determine the heat and moisture availability of the territory.

The quantitative conjugation between the drying process of fir and spruce forests of the Primorsky Krai and types of forest has been revealed, which allows us to enter the tasks of forecasting the dark coniferous forests of Primorye (Petropavlovsky, Mayorova, 2018).

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VARIETY OF VIRUSES AFFECTING CEREALS IN THE FAR EAST

Tatyana I. PLESHAKOVA¹, Nadezhda N. KAKAREKA¹, Mikhail V. SAPOTSKIY¹,
Vera A. LEDNEVA¹, Mikhail Yu. SHCHELKANOV^{1,2,3}

¹ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

² Far Eastern Federal University, Vladivostok, Russia

³ Federal Budget Institution of Health "Center for Hygiene and Epidemiology in Primorye Territory", Vladivostok, Russia.

Viral diseases of plants are important factor affecting the yield of crops and the commodity qualities of agricultural production. Nowadays, over 80 virus species affecting *Poaceae* plants are described, and more than 40 of them infect cultivated cereals.

Barley stripe mosaic virus (BSMV) (*Virgaviridae*, *Hordeivirus*) is the most common virus in the Far East. The virus is quite contagious and easily transmitted mechanically. BSMV is characterized by very high level of vertical transmission by seeds (up to 90–100 %). This biological peculiarity of the virus as well as the presence of wild host plants (especially weeds, for example *Setaria viridis*, and *Avena fatua*) allows BSMV to survive for a long time in agro- and natural biocenoses. Wheat stripe mosaic virus is another member of *Hordeivirus* detected in a restricted amount in cereals. It affects oats, barley, wheat, and corn. This pathogen is spread by *Aceria tulipae* mites. One more hordeivirus – poa semylatent virus (PSV) – is transmitted mechanically and affects oats, wheat and barley.

Northern cereal mosaic virus (NCMV) (*Mononegavirales*, *Rhabdoviridae*, *Cytorhabdovirus*) is one of the most important virus detected in barley and other cereal crops in the Far East. External symptoms of the cereal disease were expressed in dwarfism, increased bushiness and mosaic on leaves and leaf sheaths. The virus was most widely spread in oats of Amur Region. The pathogen is transmitted by *Laodelfax striatellus*. This pathogen can be reserved in wild cereals: *Calamagrostis langsdorfii*, *Agrostis gigantea*, *A. stolonifera*, *Alopecurus pratensis*, and annual weeds.

Brome mosaic virus (BMV) (*Bromoviridae*, *Bromovirus*) was registered in barley plants with symptoms similar to stripe mosaic, but without necrotic spots. It has isometric (28–30 nm) virions and easily transmitted mechanically by both imago and larvae of *Oulema melanopus*, *Chaetocema aridula*, and *Phylotreta vittula*. This pathogen has many natural hosts including *Bromopsis inermis*, *Eritrigia repens*, *Spodiopogon sibiricus*, *Calamagrostis langsdorfii*, *Echinochloa crusgali*, and *Phleum pratense*.

Rice stripe mosaic virus (RSV) (*Bunyavirales*, *Phenuiviridae*, *Tenuivirus*) transmitted by *Laodelphax stiatella* was identified due to immunochemical approaches. New Tenuivirus named Russian oat mosaic virus (ROMV) was first revealed in oats, and then in barley with bush dwarfism in Primorye Territory.

Barley yellow dwarf virus (BYDV) (*Luteoviridae*, *Luteovirus*) was detected in

the Far East. It is a dangerous pathogen easily transmitted by aphids (*Sitobion avenae*, *Schizaphis gramina*, and *Rhopalosiphum padi*). The virus has isometric (30 nm) virions and not transmitted mechanically.

In the Far East 6 phytoviruses causing corn diseases were documented: barley yellow dwarf virus (BYDV), maize dwarf mosaic virus (MDMV), barley stripe mosaic virus and viruses not peculiar for cereals, such as cucumis mosaic virus (CMV), bean yellow mosaic virus (BYMV), and alfalfa mosaic virus (AMV). Almost all of the above viruses are transmitted by aphids (except BMV).

The study was supported by Russian Foundation for Basic Research, project 8-016-00194_a.

THE *POACEAE* FAMILY IN THE RUSSIAN FAR EAST: MAIN FEATURES OF BIODIVERSITY

Nina S. PROBATOVA

Federal Scientific Center of the East Asia Terrestrial Biodiversity FEB RAS, Vladivostok, Russia

The author was studying the Grass Family *Poaceae* (P) in the flora of the Russian Far East (RFE) for more than 50 years, with respect to biodiversity, taxonomy, morphology, chromosome numbers, geographical distribution, ecology, evolutionary relationships. In RFE about 1/3 of P spp. of Russia occur. New taxa in *Agrostis*, *Arctopoa*, *Arundinella*, *Calamagrostis*, *Cleistogenes*, *Deschampsia*, *Eragrostis*, *Hierochloë*, *Hyalopoa*, *Milium*, *Poa*, *Puccinellia*, *Setaria* were revealed by the author. P of RFE is the most studied caryologically: chromosome numbers in more than 70% grass spp. are known from local material. The hybridization as the source of advanced lines of development is very important, the anthropogenic factor takes the increasing role in this process. The wide scale of natural hybridization in *Poa*, *Agrostis*, *Calamagrostis*, *Deschampsia*, *Hierochloë* stimulates the “approaching” of morphological limits of spp. The discovery of diploid “races” within the limits of geographical range in polymorphous spp. or finding of diploid representatives in the group of closely relative spp. makes possible to reveal the most ancient part of this geographical area.

The RFE is characterized by considerable originality of P in comparison with Siberia. Original features are conditioned by the influence of the Pacific, monsoon climate, very special hydrological regime of the rivers (Amur and others), caused by monsoon rains (with two floods – in spring and in summer), 3/4 mountainous relief and volcanic activities. The large genera of P in RFE and Siberia reflect well the special features of these regions: differential species of *Agrostis*, *Calamagrostis*, *Deschampsia*, *Elymus*, *Festuca*, *Glyceria*, *Hierochloë*, *Leymus*, *Poa* indicate the different centers of origin and biodiversity. The sectional composition of *Poa* is more diverse in the RFE. P of arid regions are poorly represented in RFE, moreover they occur at seacoasts. Halophytic component of P is composed by seacoastal spp. In the relict sect. *Homalopoa* (gen. *Poa*) in Siberia and the RFE no common spp. occur. Among indigenous P of RFE the predominance of oceanic and sub-oceanic spp. (including endemics) was revealed: those spp. and their areas, oriented to the Pacific, have been formed under its influence. In *Poa*: the spp. of sect. *Malacanthae*, as well as their hybrid derivatives, are characteristic for the RFE, while in Siberia the arid spp. of the sect. *Stenopoa* are well developed. The areas with concentration of endemics in RFE: east macroslope of Sikhote-Alin’ Mts; Kolyma – Okhotia region; the Amur River basin; Kamchatka Peninsula; the North Sakhalin and its east coast; and the Kurils. In evolution of *Poa* the hybridization processes play the significant role, it is characteristic not only of advanced groups (*Poa*, *Stenopoa*), but also in regressive ones (polyploid species of *Homalopoa* in the

RFE). The author established in *Poa* the new sect. (notosection) *Poastena* Prob., which combines the features of sections *Malacanthae* and *Stenopoa*. The *Poastena* are especially characteristic for the RFE coasts. The RFE is the center of taxonomic variability for *Poa*, *Agrostis*, *Calamagrostis*, *Deschampsia*, *Hierochloë*, *Glyceria*.

Now the monograph "Poaceae of Russia" is in process of publication. It contains the data of taxonomy, geography, ecology and chromosome numbers for 1417 species from 174 genera. The book was written by N.N. Tzvelev and N.S. Probatova.

LAND SNAIL SPECIES NEW FOR PRIMORYE TERRITORY AND RUSSIAN MALACOFUNA

Larisa A. PROZOROVA, Kseniya V. FOMENKO

Federal Scientific Center of the East Asia Terrestrial Biodiversity FEB RAS, Vladivostok, Russia

Here we present main results of long-term malacofaunal survey in the Primorye Territory. During last 20 years we collected land snails in different districts and habitats within the region including islands of the Peter the Great Bay and natural reserves. As a result the first regional list of 64 species in 31 genera and 21 families is compiled, including many new records. This is the most recent data on land snail fauna diversity in Primorye Territory based on modern taxonomic achievement. Before that list three another lists of terrestrial malacofauna inhabiting natural reserves within the region were published – Far East Marine Biosphere Reserve, Natural Reserve Kedrovaya Pad' and Ussuriysky Natural Reserve [Prozorova, 2004, 2006; Fomenko et al., 2015]. The most high mollusc diversity was revealed in oldest natural reserve Kedrovaya Pad' dwelled by 32 land snail species in 17 genera and 14 families [Prozorova, 2006]. Land snail fauna diversity in whole Primorye Territory exceeds this species number twice because of many new records of both native and introduced species done later.

Among listed below 64 species 10 species are new for Primorye Territory including these two first recorded in Russia and another four not identified species. These four species should be described as new for science: *Oxyloma* sp., *Pyramidula* aff. *rupestris*, *Lehmannia* aff. *valentiana*, *Stygius* aff. *stuxbergi*. Six species first recorded in Primorye Territory are as follows: *Oxyloma insularis*, *Planogyra asteriscus*, *Gastrocopta nostra*, *Columella* cf. *acicularis*, *Oxychilus translucidus* and *Zonitoides nitidus*. The last two species natively distributed in temperate regions of Northern Hemisphere were recently introduced to Southern Primorye and Khanka Lake basin. The first two species new for Primorye Territory were recorded before in other regions of the Russian Far East [Sysoev, Schileyko, 2009]. The other two species *Gastrocopta nostra* and *Columella* cf. *acicularis* are new for the Russian malacofauna. *Gastrocopta nostra* described in North Korea is found on wet rocks along coast line of Ussuriysky Bay. There are only two sited in the vicinity of Vladivostok. This is very rare and vulnerable land snail characterized by the largest shell in the genus. *Columella* cf. *acicularis* was recorded on small Moiseev Island in the Peter the Great Bay. The only dry shell was collected in leaf litter on the meadow near sea show.

All mentioned here material is deposited in malacological collection of the Center (Vladivostok). Below the list of 64 land snail species found in Primorye Territory is presented.

Diplommatinidae

1. *Palaina amurensis* (Mousson, 1887) (syn.: *Palaina pusilla* (von Martens, 1877) - ?)

Carychiidae

2. *Carychium cymatoplax* Pilsbry, 1901
3. *C. pessimum* Pilsbry, 1902
4. *C. sibiricum* Westerlund, 1897

Succineidae

5. *Succinea lauta* Gould, 1858
6. *Oxyloma insularis* (Mousson, 1887) - new species for Primorye Territory
7. *Oxyloma* sp.

Cochlicopidae

8. *Cochlicopa likharevi* Starobogatov, 1996
9. *C. lubricella* (Ziegler in Porro, 1838)
10. *C. maacki* Starobogatov, 1996

Strobilopsidae

11. *Eostrobilops coreana* Pilsbry, 1927

Valloniidae

12. *Vallonia chinensis* Suzuki, 1944
13. *V. kamtschatica* Likharev, 1963
14. *V. patens patens* Reinhardt, 1883
15. *V. peteri* Schileyko, 1984
16. *V. pulchelulla* (Heude, 1882)
17. *Zoogenetes harpa* (Say, 1824)
18. *Planogyra asteriscus* (Morse, 1857) – new species for Primorye Territory, found in the vicinity of Vladivostok

Pupillidae

19. *Gibbulinopsis cryptodon* (Heude, 1880)
20. *Pupilla alabiella* Schileyko, 1984
21. *P. muscorum* (Linnaeus, 1758)

Gastrocoptidae

22. *Gastrocopta nostra* Pokryczko et Stworzevicz, 2004 – new species for Russian fauna and Primorye Territory, found in the vicinity of Vladivostok
23. *G. theeli* (Westerlund, 1877) (syn.: *Gastrocopta coreana* Pilsbry, 1916)

Vertiginidae

24. *Vertigo alpestris* Alder, 1838
25. *V. japonica* Pilsbry et Hirase, 1904 (syn.: *Vertigo coreana* Pilsbry, 1919, *V. tosana* Pilsbry, 1919)

26. *V. microsphaera* Schileyko, 1984
27. *Columella columella* (G. Martens, 1830)
28. *C. edentula* (Draparnaud, 1805)
29. *Columella* cf. *acicularis* Almuhambetova, 1979 – new species for Russian fauna found in Moiseev Is., Peter the Great Bay

Pyramidulidae

30. *Pyramidula* aff. *rupestris* (Draparnaud, 1801)

Punctidae

31. *Punctum conspectum* (Bland, 1865)
32. *P. pygmaeum* (Draparnaud, 1805)
33. *P. ussuriense* Likharev et Rammelmeyer, 1952

Discidae

34. *Discus depressus* (A. Adams, 1868)
35. *D. ruderatus pauper* (Gould, 1859)

Gastrododontidae

36. *Hawaiiia minuscula* (Binney, 1840)
37. *Perpolita hammonis* (Strøm, 1765)
38. *Oxychilus translucidus* (Mortillet, 1853) – new species for Primorye Territory, introduced to Southern Primorye and Lake Khanka basin

Zonitidae

39. *Zonitoides nitidus* (Müller, 1774) – new species for Primorye Territory, introduced to the vicinity of Vladivostok
40. *Discoconulus sinapidium* Reinhardt, 1877

Euconulidae

41. *Euconulus fulvus* (Müller, 1774)

Agriolimacidae

42. *Deroceras agreste* (Linnaeus, 1758)
43. *D. altaicum* (Simroth, 1886)
44. *D. caucasicum* (Simroth, 1901) - introduced to Southern Primorye and Lake Khanka basin from Middle Asia [Prozorova, Fomenko, 2017]
45. *D. laeve* (Müller, 1774)

Limacidae

46. *Lehmannia* aff. *valentiana* (Ferussac, 1822)

Phylomycidae

47. *Meghimatium billineatum* (Benson, 1842)

Arionidae

48. *Arion sibiricus* Simroth, 1901

49. *A. subfuscus* (Draparnaud, 1805) - introduced to the vicinity of Fokino from Europe and western North America [Prozorova, Fomenko, 2015]

Bradybaenidae

50. *Karaftohelix arcasiana* (Crosse et Debeaux, 1863)
51. *K. capillata* (Schileyko et Bratchik in Schileyko, 1978)
52. *K. dieckmanni* (Mousson, 1887)
53. *K. diversita* (Schileyko et Bratchik in Schileyko, 1978) (syn: *Chosenelix problematica* (Pilsbry, 1926) - ?)
54. *K. fragilis* (Pilsbry, 1926)
55. *K. kudiensis* (Cockerell, 1924)
56. *K. kurodana* (Pilsbry, 1926)
57. *K. maacki* (Gerstfeldt, 1859)
58. *K. middendorffi* (Gerstfeldt, 1859)
59. *K. plana* (Schileyko et Bakurov in Schileyko, 1988)
60. *K. selskii* (Gerstfeldt, 1859) (earlier as *Acusta ravidata* (Benson, 1842))
61. *K. ussuriensis* (Westerlund, 1897)

Hygromiidae

62. *Lindholmomneme notophila* (Cockerell, 1924)
63. *Pseudotrichia rubiginosa* (Rossmassler, 1838)
64. *Stygius* aff. *stuxbergi* (Westerlund, 1876)

NEW FOR THE MEKONG DELTA AND VIETNAM FAUNA MOLLUSK FAMILIES

Larisa A. PROZOROVA¹, Takumi SAITO², Konstantin A. LUTAENKO³,
Thai T. TRAN⁴, Xuan Quang NGO⁴

¹ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

² Division of Regional Ecosystem Studies, Graduate School of Life Sciences, Tohoku University, Sendai, Japan

³ National Scientific Center of Marine Biology FEB RAS, Vladivostok, Russia

⁴ Institute of Tropical Biology, Vietnam Academy of Science and Technology, Ho Chi Minh City, Vietnam

During 2017–2018 a comprehensive malacofaunal survey was undertaken in the Mekong Delta in frame of the Russian–Vietnamese ecological study of the Mekong Delta (FEB RAS – ITB VAST 17-000). Freshwater, brackish water, terrestrial and mangrove mollusks were collected in more than 100 sites in different provinces within the delta. As a result not only species but taxa of genus and family groups are first recorded for the Mekong Delta and whole Vietnam. Here we present four such records as followings: new for Vietnam families Amphibolidae and Dreissenidae and new for the Mekong Delta families Onchidiidae and Pholadidae.

Mollusks belonging to the first three families were found when collecting in mangrove forest of Kien Luong District of the Kien Giang Province. Air-breathing rare snail *Lactiforis* cf. *tropicalis* Golding, Ponder et Byrne, 2007 (Gastropoda, Pulmonata, Amphibolidae) was found in two sites in Kien Luong District of the Kien Giang Province. First habitat was shallow puddle in the gap of mangrove tangle near tidal lake Ba Tai, and the second that was soft mud in open mangrove forest with many creeks near coast line. Amphibolids are not obligate mangal species but mud creepers, sometimes occurring at the mangal periphery. These are only mangrove pulmonates characterized by the presence of an operculum in adults. The family is poorly studied because of very limited, local occurrence.

Invasive false mussel, *Mytilopsis adamsi* Morrison, 1946 (Bivalvia, Veneroidea, Dreissenidae) was found to be abundant in tidal brackish water lake Ba Tai. Druses of the species cover stones on the lake bottom. That dreissenid mussel originally described from Panama Bay invaded the Indo-Pacific Ocean during the 19th century and has reached the Gulf of Thailand and Vietnam to the 21th. This is the first record of the false Adams's mussel in Vietnam. The finding indicates that the spread of *M. adamsi* is still in progress and that this invasive mussel continues to colonize brackish waters of Vietnam.

Onchidiid slugs (Gastropoda, Pulmonata) were first found to inhabit mangroves in two provinces of the Mekong Delta Bac Lieu and Kieng Giang in May 2018. That group of true slugs (with no internal shell) shares its habitat in intertidal

mangrove, saltmarsh and estuarine mudflat with other pulmonates in Ellobiidae and Amphibolidae. In Keim Giang Province slugs in two species *Melayonchis cf. eloisae* Dayrat in Goulding et al., 2017 and *Melayonchis cf. siongkiati* Dayrat and Goulding in Goulding et al., 2017 were collected in open mangrove forest with hard mud creeks together with many ellobiids, *Lactiforis cf. tropicalis* and pectinibranch gastropods. In Bac Lieu Province *Melayonchis cf. siongkiati* and *Onchidium stuxbergi* (Westerlund, 1883) were found in mangrove forest with creeks and many dead logs together with ellobiids and various pectinibranches. In Vietnam these three Onchidiidae species were recorded before in Can Gio mangroves [Dayrat et al., 2016; Goulding et al., 2017].

Small wood borer *Martesia cf. striata* (Linnaeus, 1758) belonging to family Pholadidae (Bivalvia, Myoida) is distributed circumglobally in temperate and tropical marine waters where it inhabits intertidal areas and shallow water in timber. The species was known for Vietnam before in Khanh Hoa Province and Tonkin Bay [Thach, 2005; Lutaenko, 2016]. In May 2018 that was found in the Mekong Delta in Ba Lai River (Ben Tre Province) under oligohaline conditions. That is the first finding of pholadids in a river estuary as well.

MANGROVE MOLLUSK FAUNA OF THE KIEN GIANG PROVINCE IN THE MEKONG RIVER DELTA (SOUTH VIETNAM)

Larisa A. PROZOROVA¹, Konstantin A. LUTAENKO², Viktor V. BOGATOV¹,
Xuan Quang NGO³, Thai T. TRAN³

¹ *Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia*

² *National Scientific Center of Marine Biology, FEB RAS, Vladivostok, Russia*

³ *Institute of Tropical Biology, Vietnam Academy of Science and Technology,
Ho Chi Minh City, Vietnam*

In Vietnam mangrove forests mainly grow along the sea coast of the Mekong Delta in Ca Mau, Bac Lieu and Kien Giang Provinces. Though molluscs are known as one of the most diverse, abundant and important components of mangrove ecosystem, their fauna within the Mekong Delta remains unexplored. Odd data on several species from Ca Mau mangroves were published by N. Thach in his overall monographs on Vietnam malacofauna [2005, 2007, 2012], and two gastropods were recorded for the Ba Tai tidal forest in Kien Giang Province when taxonomic revision of Ellobiidae [Raven, Vermeulen, 2007]. During 2017–2018 the first comprehensive malacofaunal survey was undertaken in the Kien Giang tidal forest and surrounding habitats from Rach Gia to Ha Tien, with emphasis on Kien Luong District as a part of the Kien Giang Biosphere Reserve. The study was undertaken in frame of the Russian-Vietnamese ecological study of the Mekong Delta (FEB RAS – ITB VAST 17-000).

We identified more than 60 gastropod and bivalve species in collected material from mangrove forest and neighboring area including tidal mud flat, small river estuary, sandy, muddy and rocky littoral along mangrove belt. Protected brackish water (tidal) Ba Tai Lake as well as mangrove forest with brushland around the lake and limestone Ba Tai Mt. (An Binh Commune, Kien Luong District) are recognized as mollusk diversity hot spots. The Ba Tai Mt. as important part of the Kien Luong karst hills was before also highly appreciated for its biodiversity, presented by many rare and endemic organisms including mollusks.

That protected area is now in the danger of becoming the materials for making lime and relevant human activities. Quarrying these karst hills contested by a chemical company as well as the cutting of shrimp ponds in the neighboring mangrove forest threatens its mangal strongly. Establishing of nature reserve planned by local government and discussed by community is the only way to protect unique biodiversity of Ba Tai area as etalon of the Mekong Delta mangal as well as unique ecosystems of tidal lake and limestone hills dwelled by many endemic species including obligate organisms largely restricted to their special habitats.

**A KARIOLOGICAL STUDY OF SIBERIAN RUBYTHROAT
CALLIOPE CALLIOPE (MUSCICAPIDAE, AVES)
FROM THE PRIMORYE TERRITORY**

Galina V. ROSLIK, Olga P. VALCHUK, Konstantin S. MASLOVSKY

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Avian karyology still remains poorly studied so far as compared, for example, to mammalian karyology. Most descriptions of bird's karyotypes are given at the level of b-karyology, i.e. without the use of differential staining. This is due to specific characteristics of their karyotypes, which, as a rule, have a high diploid numbers, and conventional division of chromosomes into two groups: 1) a small group of large macrochromosomes and 2) a very large group of small microchromosomes.

The object of the present study is the siberian rubythroat *Calliope calliope* Pallas, 1776 (Muscicapidae, Aves) – a widespread Palearctic species, from the foothills of the Urals in the west to the shores of the Pacific Ocean in the east. There are 1–5 subspecies within species are distinguished by different authors (Stepanyan, 2003; Koblik et al., 2006, etc.).

Karyology of the species has not enough studied and without the use of differential staining (Panov, Bulatov, 1972, Ray-Chaudhuri, 1976, Bulatova, 1981), which did not allow us to reliably describe the size and morphology of the sex chromosomes and also some macrochromosomes.

We studied karyotypes of 5 specimens (2 males and 3 females) of the siberian rubythroat, using as routin staining techniques and the differential C–staining. The birds were caught in the Southern Primorye, where they belonging to different phylogenetic groups pass through the same migration corridor at the same time, according to the results of the sequencing of the cyt b DNA gene (Spiridonova et al., 2013).

Due our data it is possible to clarify the diploid number of chromosomes of this species ($2n = 82 \pm$). Using differential C–banding, the sex ZW chromosomes in females and the ZZ chromosome in males were successfully identified, and also described the morphology of the macrochromosomes of birds. The deviation in the size structure of the *C. calliope* karyotype from the basic structural scheme of Passeriformes karyotype was noted, which agrees with the opinion of other authors.

BIODIVERSITY OF SMALL FRESHWATER BIVALVES (MOLLUSCA: BIVALVIA: PISIDIOIDEA) OF THE UPPER YENISEI RIVER BASIN

Mariana O. SHARYI-OOL

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

The Upper Yenisei River fauna of small freshwater bivalves (Pisidioidea: Sphaeriidae, Pisidiidae, Euglesidae) is characterized by a high taxonomic diversity: 60 species belonging to 18 genera (Zhadin, 1933; Zhadin, 1952; Greze, 1957; Greze, 1958; Gundrizer, Ivanova, 1969; Johansen, Cheremnov, 1969; Starobogatov, Streletzkaja, 1967; Cheremnov, 1973, Cheremnov, 1974, Zasypkina, 2001; Dolgin, Puzikova, 2004; Zasypkina, 2006; Dolgin, Puzikova, 2007; Prozorova, Zasypkina, 2010; Dolgin, 2012; Dolgin, 2013; Sharyi-ool (Zasypkina), 2014; Sharyi-ool, 2017). In this report is to show species composition of small freshwater bivalves (Mollusca: Bivalvia: Pisidioidea) in the Upper Yenisei River basin within the Republic of Tuva where during 1994 and 2017 in all freshwater kinds of lotic and lentic habitats were collected the pea clams. Almost 1860 shells and specimens were fixed in 75% alcohol; the collection is now deposited at the Federal Scientific Center of the East Asia Terrestrial Biodiversity FEB RAS, Vladivostok. Shells and specimens were investigated by conchological, anatomical and SEM methods based on original study. Conchological characters include shell outline, sculpture, features of hinge, ligament, muscle scars and pores; the most important structures are illustrated on the SEM photographs. Anatomical characters were studied in situ and figured with a camera lucida. At present, based original data, 52 species from 3 families Sphaeriidae, Pisidiidae, Euglesidae were found: 12 species in 5 genera of the Sphaeriidae, 5 species in 2 genera of the Pisidiidae, 34 species in 11 genera of the Euglesidae. One subfossil species was found in Recent time. The majority of species are distributed in the Palearctic Region, while the other species have Siberian distribution.

RARE AND POORLY STUDIED SPECIES OF PARASITES OF CYPRINID FISH FROM THE PRIMORYE TERRITORY

Marina B. SHEDKO¹, Alexey V. ERMOLENKO¹, Nadezhda L. ASEEVA²

¹ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

² Pacific Research Fisheries Center (TINRO-Center), Vladivostok, Russia

Amur carp *Cyprinus carpio haematopterus* Temminck and Schlegel and gibel carp *Carassius gibelio* Bloch are one of the main objects of commercial and amateur fishing and aquaculture in freshwater reservoirs of the southern Russian Far East which is part of their native area. An important cause of its losses in pond farming is the parasitic diseases.

In general, the parasite fauna of these fish species has been studied quite fully in the region, revealed nearly 100 species of parasites, most of which have a simple life cycle (Akhmerov, 1955, 1960; Strelkov, Shulman, 1971; Dvoryadkin et al., 1984; Ermolenko, 1990, 1992 and others). However, continuous monitoring of the parasitological situation is necessary.

During a survey on parasites of this cyprinid fishes conducted between 2010 and 2017, new infections were found in the basin of the Khanka Lake and artificial water bodies of Primorye Territory. In particular, for the first time, three species of myxosporeans (Myxosporidia), causing myxosporidiosis fish were found. *Myxobolus divergens carassii* infections was identified of gibel carp in December–January 2014–2017 in the southern part of the Khanka Lake (8 % prevalence). This subspecies was described from the Amur River basin by Yukhimenko (1985) from this host and identical pathology. Spores of the myxosporean are localized in the muscles forming a large hump behind the head. Parasite was studied by morphological and histological methods. A hitherto unknown *Myxobolus* sp. was found on the gill filaments in amur carp in July 2015 (9 % prevalence). The presence of *Thelohanellus nikolskii* Achmerov in this lake basin was confirmed. The myxosporean isolated from cysts presented on the fins of amur carp in July 2012.

An obligate branchiurian fish ectoparasites *Argulus* spp (Crustacea) have been reported to cause problems in fisheries and fish farms (mainly in carp farming) worldwide. Still only 3 widespread species of ‘carp louse’ have been registered in Russia (*A. coregoni*, *A. foliaceus*, *A. japonicus*). According to our data, *A. mongolianus* caused the mortality of over 90 % (300 fishes) of pond-cultured common carp *Cyprinus carpio* in the suburb of Vladivostok in July 2011. *A. mongolianus* was known only accordingly by the description of the female from China (Tokioka, 1939).

Five hundred seventy specimens of amur carp and gibel carp were examined in the period from March 2010 to April 2017 for the presence of leeches *Limnotrachelobdella sinensis* (Blanchard) (Piscicolidae). From October to December juvenile leeches are found on the surface of the body and at the base

of fins, but from the end of December to June they are infected the inner surface of the operculum.

Aspidogaster ijimai Kawamura (Aspidogastrea) was found in the amur carp esophagus for the first time in Russia.

The data obtained by us on new pathogens of fish diseases should be taken into account in conditions of active development of aquaculture in the region.

**ANTARCTOPHTHIRUS NEVELSKOVII – A NEW SPECIES OF
ECHINOPHTHIRIIDAE LICE FOUND IN THE NORTHERN FUR SEAL**

Mikhail Yu. SHCHELKANOV^{1,2,3}, Tatyana V. MOSKVINA²,
Egor M. SHCHELKANOV²

¹ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

² Far Eastern Federal University, Vladivostok, Russia

³ National Scientific Center of Marine Biology, FEB RAS, Vladivostok, Russia

The sucking lice from the family *Echinophthiriidae* are specific parasites of pinnipeds. These insects have adapted to living in the sea by inhabiting in the upper respiratory tract of pinnipeds. There is relatively scant information about systematic, morphology and biodiversity of these ectoparasites. Totally two *Echinophthiriidae* species including *Antarctophthirus callorhini* (Osborn) and *Proechinophthirus fluctus* (Ferris) were described from the northern fur seal *Callorhinus ursinus* (L.). However, *Echinophthiriidae* species have never been previously described from the Okhotsk Sea.

During expedition to the Tyuleniy Island situated near Sakhalin Terpeniya Cape we investigated nasal cavities of fur seal puppies, and louse was collected. Totally 15 specimens were examined including 1 females and 11 males and 4 nymphs. Louse was prepared following the slightly modified protocol of Palma (1978). The specimens were treated with 20 % aqueous solution of potassium hydroxide (KOH) for 24 h. The KOH was removed and replaced by distilled water for 30 min, and then by 10 % of aqueous solution of acetic acid. The acetic acid neutralizes the remaining alkali, stopping maceration and avoiding damage by over treatment. The specimens were dehydrated in an ethanol series 70 %, 80 %, 90 % and 96 % for 30 min at each concentration. After dehydration, the alcohol was replaced by pure clove oil for 24 h. The lice were placed on the slide with some drops of glycerol added and flattened the coverslip.

The male body length turned to be 2.7 mm, female – 3.2 mm. Head lightly longer than wide (length 0.35, width 0.42); anterior margin heavily sclerotized, maxillary vestige distinct, ventral labrum connected to long apodemes; postantennal angle development, dorsally with two long hairs in both sides; posterolateral angle not developed antennae with 5 segments. Basal segment has a short spine. Terminal segment has equal size with 4 segments with sensoria at apex. Thorax trapezoidal, longer than head and twice as wide, with many setae of various lengths both dorsally and ventrally; 3 dorsal mesothoracic spine, 4 dorsal metathoracic spines arranged in 2 rows and 3 dorsal marginal abdominal hairs. Abdomen: large, oval, without distinctive tergites or sternites; paratergal plates are not developed; six spiracles present; posterior margin lightly elongated. Totally 9 row of setae of various shapes and size are appeared in abdomen; scale-like setae occupy the most part of the abdomen (4–9 rows). The forms and types of setae covered the head, thorax and abdomen are distinguished this species from the *A. callorhini*. The lo-

calization of setae on the head and thorax similar with *A. carlinii*, described from Weddell seal *Leptonychotes weddelli*, however the shape and size of male genitalia are distinguished in both species.

Thus, one could conclude that the unique features of lice from the Tyuleniy Island mentioned above are enough evidence to further describe it as a new species. We have suggested to name this new species as *Antarctophthirus nevelskoy* – after the famous Russian admiral Gennady Ivanovich Nevelskoy (1813–1876), who discovered that Sakhalin was the Island.

The study was supported by the Program of fundamental research of the Far Eastern Branch of the Russian Academy of Sciences «Far East» (2018–2020), project 18-5-060.

MOLECULAR-GENETIC IDENTIFICATION OF TWO PARAMUSHIR VIRUS (*BUNYAVIRALES*, *NAIROVIRIDAE*, *ORTHONAIROVIRUS*) STRAINS ISOLATED ON THE TYULENIY ISLAND IN THE OKHOTSK SEA

Mikhail Yu. SHCHELKANOV^{1,2,3}, Vladimir G. DEDKOV^{4,5}, Kamil F. KHAFIZOV⁴, Marina V. SAFONOVA⁶, Alina D. MATSVAY⁴, Anna S. SPERANSKAYA⁴, Andrei A. AYGININ⁴, Egor M. SHCHELKANOV², Anna S. DOLGOVA⁴, Nadezhda N. KAKAREKA¹, Ekaterina V. PIMKINA⁴, Irina V. GALKINA², German A. SHIPULIN⁴

¹ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

² Far Eastern Federal University, Vladivostok, Russia

³ National Scientific Center of Marine Biology, FEB RAS, Vladivostok, Russia

⁴ Central Research Institute for Epidemiology, Federal Service on Consumers' Rights Protection and Human Well-Being Surveillance, Moscow, Russia

⁵ Pasteur Institute, Saint-Petersburg, Russia

⁶ Moscow Anti-Plaque Center, Moscow, Russia

During arbovirus surveillance *Ixodes uriae* ticks were collected in the nest colonies of seabirds on the Tyuleniy Island (48° 29' N, 144° 38' E) in the Okhotsk Sea near Sakhalin Terpeniya Cape. The *I. uriae* identity and sex of the ticks were determined based on their morphology. All of the ticks were stored alive in a wet chamber until separation. Ticks were separated by species, sex, developmental stages, and later processed in pools of 10 imago or 25 preimago.

Viruses were isolated using intracerebrally inoculated newborn mice. Two strains of Paramushir virus (PMRV) (*Bunyavirales*, *Nairoviridae*, *Orthonairovirus*) were obtained: PMRV/*Ixodes uriae*/Russia/Tyuleniy Island/133/2015 and PMRV/*Ixodes uriae*/Russia/Tyuleniy Island/137/2015. Biological samples were homogenized using Tissue Lyser LT (Qiagen, Germany) for 5 min in 100 µL of phosphate buffered saline (pH 7.0) before extraction, centrifuged at 2000 rpm for 10 min, and the supernatant was used for nucleic acid extraction. Total nucleic acids were extracted and purified using the RIBO-prep DNA/RNA extraction kit (k2-9-Et-100CE, AmpliSens, Russia), according to the recommendations of the manufacturer. DNA/RNA was eluted with 50 µL of the elution buffer (AmpliSens, Russia) and stored at -70 °C until evaluation. Broad-range RT-PCR was performed using a set of broadly reactive degenerate oligonucleotides designed to target each viral species that could be transmitted by ticks within the genera as follows: *Flavivirus*, *Orthonairovirus*, *Phlebovirus*, *Orthobunyavirus*, *Orthoreovirus*, *Orbivirus*. All PCR products of the expected size were cut out from the gel under UV control, extracted using a MinElute gel extraction kit (Qiagen, Germany) and ligated into the pGEM-T plasmid vector (Promega, USA). These plasmids were transformed into *Escherichia coli* (XL1 blue strain) and 10 white colonies were sequenced using standard M13R primers by means of the ABI Prism 3500 XL (Applied Biosystems, USA). Obtained se-

quences were examined using the Basic Local Alignment Search Tool (BLAST). As a result, 489 436 and 358 075 reads were obtained for the samples PMRV-133 and PMRV-137, respectively. However, obtained reads were distributed unequally. In particular, L-segments were covered at 95.7 % and 98.4 % (for PMRV-133 and PMRV-137, respectively), M-segments were covered at 23.0 % and 72.8 %, whereas S-segments were covered at 100 % for the both strains. Existing gaps were sequenced using Sanger sequencing technique by means of the ABI Prism 3500 XL (Applied Biosystems, USA). PMRV-133 and PMRV-137 strain nucleic acid sequences were submitted to GenBank under accession numbers MH124637, MH124638 and MH124634-MH124636, respectively. Phylogenetic analysis showed that both sequenced strains were closely related to PARV LEIV-1149K strain within the Sakhalin virus subgroup.

The study was supported by the Program of fundamental research of the Far Eastern Branch of the Russian Academy of Sciences «Far East» (2018–2020), project 18-5-060.

LICHENS OF ROCKY HABITATS (THE SOUTHERN PART OF THE RUSSIAN FAR EAST)

Irina F. SKIRINA, Ilona M. RODNIKOVA, F.V. SKIRIN

Pacific Geographical Institute, FEB RAS, Vladivostok, Russia

Little work has focused on the saxicolous lichen communities of the southern part of the Russian Far East. The major reasons for this are inaccessibility of the habitats, identifying difficulties etc. I. Skirina with co-authors attempted to compile a list of the saxicolous lichens of rocky habitats in 2006. The list consisted of 481 species. Now the list includes 697 lichens. We used own material as well as published data.

Location of the study area at the crossroads of Eurasia and the Pacific ocean has led to unique environmental conditions and monsoon climate as well. The most of the area of the southern part of the Russian Far East is characterized by mountain relief. Rocky habitats are rock outcrops, scree of various origin, boulders and coastal gravels. Our study comprises saxicolous lichens from upper limits (1650–1700 m. a.s.l.) up to the coast of the Sea of Japan.

Our study has shown that lichenflora of rocky habitats is the richest one of the southern part of the Russian Far East. Epilithic lichens growing on the rock surfaces are the main part of the flora. They belong to the families: Lecideaceae, Verrucariaceae, Lecanoraceae, Umbilicariaceae, Acarosporaceae, Pertusariaceae, Stereocaulaceae, Psoraceae, Candelariaceae, Chrysothricaceae, Ramalinaceae, Graphidaceae, Telotremataceae, Rhizocarpaceae, Sphaerophoraceae etc. Secondary epilithic lichens being trunk epiphytic lichens are common as well. Families Physciaceae, Teloschistaceae, Collemataceae, Pannariaceae, Lobariaceae, Pertusariaceae and Parmeliaceae contain them. Epigeic species growing on thin soil layer in cracks of rock bottoms are the large group as well. These lichens occur in families Alectoriaceae, Parmeliaceae, Cladoniaceae, Peltigeraceae, Verrucariaceae. Families Gyalectaceae, Telotremataceae, Pertusariaceae include epibryophytes.

Lichens which are epiphytic species in the centres of their distribution areas while in the study area they grow on the rocks are of great interest. The examples are *Lobaria retigera*, *Punctelia ruddecta*, *Coccocarpia palmicola*, *Pyxinae soreidiata*. Among epilithic lichens *Parmelia saxatilis* being secondary epiphytic species grow both on bark and on rocks.

The saxicolous lichenflora comprise species of various life-forms: foliose, crustose, fruticose. Crustose lichens of genera *Acarospora*, *Amygdalaria*, *Aspicilia*, *Bellemeria*, *Caloplaca*, *Lecanora*, *Lecidea*, *Pertusaria*, *Porpidia*, *Rhizocarpon*, *Verrucaria* etc. are the dominant (more than 41% of the total). Foliose species include about 35% from the genera *Arctoparmelia*, *Asahinea*, *Coccocarpia*, *Dermatocarpon*, *Melanelia*, *Parmelia*, *Umbilicaria*, *Xanthoparmelia*. Twenty three percent of the species have fruticose life-forms from the genera *Philoporus*, *Ramalina*, *Sphaerophorus*, *Stereocaulon*, *Teloschistes* etc.

According to heat, humidity and snow cover depth relations 7 ecological lichen groups were distinguished. Psychrophytes (species of cold and wet environment) are common in scree habitats. The examples of psychrophytes are *Parmelia omphalodes*, *Umbilicaria vellea*. Mesophytes which prefer moderate wet environment are *Cladonia scabriuscula*, *Cetraria laevigata*, *Stereocaulon incrustatum*, *Melanelia disjuncta* etc. Cryophytes being species of the coldest and driest environment prefer northern windward slopes of non-forested belt. *Arctoparmelia incurva*, *Umbilicaria caroliniana*, *Flavocetraria nivalis*, *Asahinea chrysantha* are cryophytes. Xerophytes adapted to warm and dry environment grow on the southern and western slopes where they experience high insolation (for example *Lecanora frustulosa*, *Dimelena oreina*, *Melanelia tominii*). Xeromesophytes (*Caloplaca decipiens*, *Aspicilia cinerea*), which prefer warm environment, grow in shade habitats. Hygrophytes growing in occasionally inundated environment are *Dermatocarpon luridum*, *Verrucaria mucosa*. Halophytes being coastal species include *Ramalina kardakovae*, *R. litoralis*, *Verrucaria striatula*.

Geographical and environmental features of the region have led to high diversity of unique lichen communities of rock habitats.

MOLECULAR IDENTIFICATION OF FAR EASTERN LEOPARD PATHOGENS: *SPIROMETRA* CASE

Nadezhda S. SULIKHAN^{1,2}, Marina B. SHEDKO¹, Lyudmila V. ZHELEZNOVA³,
Yulia A. MELNIKOVA⁴, Sergey V. SHEDKO¹

¹ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

² Federal State Budgetary Institute «Land of the Leopard», Vladivostok, Russia

³ Department of Cell Biology and Genetics, Far Eastern Federal University,
Vladivostok, Russia

⁴ Khingansky State Nature Reserve, Arkhara village, Amur Region, Russia

In the fall of 2015, on Razdolnoye-Slavyanka highway, near Kravtsovka settlement, Khasansky rayon, in the territory of the national park “Land of the Leopard”, an eight-year-old male of Far Eastern leopard (*Panthera pardus orientalis*) was hit by a car. Posthumously, during the intestine examination, segments of adult cestodes were found in its cavity. Earlier, in February 2011, six adult cestodes were detected in the intestine of Leopard cat (*Prionailurus bengalensis euptilurus*) found dead near Kraskino settlement in the same district.

Morphological investigation identified the helminthes as *Spirometra* sp. To specify the species of cestode, we applied the molecular genetic analysis. We have tested three fragments of helminthes found in the Leopard and one of six helminthes found in the Leopard cat on a mitochondrial COI gene fragment. All samples were identified as *Spirometra erinaceieuropaei* (Rudolphi). Haplotypes of parasites found in 2015 and 2011 were significantly different. Haplotype from the Leopard turned out to be distinct and entered the cluster with sequences from Laos, Vietnam and Japan. And haplotype obtained from Leopard cat was identical to haplotypes widespread in eastern China, there was also one report from Australia.

The final hosts of *Spirometra* spp. are representatives of the families Felidae and Canidae, sometimes human. The genus *Spirometra* represented by several species, where *S. erinaceieuropaei* and *S. mansonioides* Mueller are the most common. *Spirometra* spp. causes such diseases of animals and humans as spirometriasis and sparganosis. Contagion occurs through the eating of prey or poorly processed meat infected by plerocercoids and water contained infected copepods. It is known that in Tapeworms (cestodiasis), clinical signs such as increased fatigue, diarrhea, intestinal cramps, dizziness, weight loss appear only in 20% of cases (Xiao, 2015). Sparganosis poses a greater threat, it is characterized by the penetration and localization of parasite larvae in organs and tissues of the host, causing local inflammation. Human sparganosis was registered in Africa, southern Asia, California and Japan, rarely feline can be affected by sparganosis (Miyazaki, 1991; Bowman et al, 2002). Nevertheless, for the Far Eastern leopard, numbering about 80–100 individuals, combined with the need to successfully hunt, compete for the site, winters and such stochastic phenomena as snow-capped and extremely cold winters, outbreaks of infectious diseases – any deviations in health

can significantly affect the survival of individual. Moreover, there have been cases of a sharp decrease in the number of large felines due to outbreaks of infectious diseases aggravated by extreme environmental conditions and parasitic invasions, for example, African lions in Serengeti and Amur tigers in Sikhote-Alin Zapovednik (Munson, 2008; Miquelle, 2015).

This is the first report on genetically confirmed presence of *S. erinaceieuropaei* in the south of Primorye Territory. Both cases of parasitism of adult helminthes in Red List wild felines prove the presence of parasite in the given territory. Simultaneously, the potential for successful circulation of *S. erinaceieuropaei* provides by a wide variety of intermediate, paratenic and final hosts inhabiting here, favorable environmental conditions such as abundance of water bodies, and disease presence (spirometriasias and sparganosis) in neighboring China, Korea and Japan.

We are grateful for cooperation with the National Park "Land of the Leopard" and the Primorsky State Agricultural Academy.

ENDOPHYTIC FUNGAL COMMUNITY AND SUCCESSION OF *TAMARIX RAMOSISSIMA* CULTIVATED IN JILIN, CHINA

Yue SUN, Mingqi SHAO, Wencheng CHI, Shuwei WEI, Odeshnee MOODLEY,
Qi WANG, Makoto KAKISHIMA

*Engineering Research Centre of Chinese Ministry of Education for Edible and Medicinal
Fungi, Jilin Agricultural University, Changchun, Jilin Province, 130118, China*

Endophytic fungi can colonize any tissue or part of its host through varying degrees of symbiosis, ranging from facultative saprobic to parasitic, exploitive to mutualistic. Endophytes are important components of plant micro-ecological systems and play important roles in vegetative and reproductive growth, especially under the severe environmental stresses like drought, changes in salinity, as well as the pressures applied by pathogens and insect pests.

Tamarisk is deciduous shrub mainly growing in dry areas like deserts with a reported 60 species representing the genus *Tamarix* (Tamaricaceae) in the world and about 20 species in China alone. Some species are also used as ornamental shrubs and are cultivated in parks and gardens due to the abundance of dense feathery racemes produced at the top of their branches. They usually grow in saline soils, tolerating both high salinity and alkaline conditions. Therefore, these plants are grown in relatively hostile conditions to prevent desertification in China.

However, endophytic fungi of *Tamarix* species has not been investigated sufficiently. Therefore, here, the endophytic fungal community of *T. ramosissima* growing on the campus of Jilin Agricultural University, Changchun, Jilin, China were examined. Plant samples were collected from February to September (2017 to 2018) on a monthly basis and subsequently endophytic fungi isolated from the leaves and stems after prior surface sterilization. Fungal isolates were identified via morphological observations and molecular methods. *Alternaria tenuissima*, *A. alternata*, *Alternaria solani*, *Alternaria* sp., *Aspergillus* sp. and some unidentified fungi were detected. *Alternaria* species were most dominant having been detected in all seasons isolated from leaves and stems, and *A. tenuissima* was detected in the highest quantity in the samples. However, the fungal diversity from the samples was relatively low when measured using Shannon's index, Fisher's α , and Simpson's index. No significant difference of fungal community in different seasons was observed. These results suggested that *Alternaria* may play an important ecological role in growth of the plant.

**FEATURES OF VARIABILITY IN THE ITS1 REGION
OF *CLONORCHIS SINENSIS* (TREMATODA: OPISTHORCHIIDAE)**

Yulia V. TATONOVA¹, Galina N. CHELOMINA¹, Hung Manh NGUYEN²,
Vladimir V. BESPROZVANNYKH¹

¹ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

² Institute of Ecology and Biological Resources, Vietnam Academy of Science and
Technology, Hanoi, Vietnam

Clonorchis sinensis (Cobbold, 1875) is an epidemiologically important trematode that inhabits East and South–East Asia. Investigation of parasite genetic diversity is important for understanding its biology and biogeography, as well as for the development of the basis for the treatment, control, and prognostic estimation of invasion spread. In present study, the ITS1 rDNA nucleotide sequences were used for analysis of variability in Russian and Vietnamese populations of *C. sinensis*. In addition, the data obtained were compared with relevant sequences for the parasite from other countries (China, Korea). Despite the low level of variability, this marker has revealed some features. First, the intragenomic polymorphism at the 114, 139, and 339 bp positions of the complete ITS1 sequences was identified for *C. sinensis* from Russia and Vietnam, while sequences of Chinese and Korean samples had no this type of variability. Second, frequencies of ITS1 sequences with a 5 bp insertion (GCCTG) differed in *C. sinensis* populations from different countries: 8, 12, 47 and 53% in Russia, Vietnam, China and Korea, respectively. Third, substitutions upstream and downstream of this insertion were analyzed. No sequences with nucleotide substitutions both upstream and downstream of the 5 bp insertion were found in this study. The population of northern China had both variants of sequences with substitutions either upstream or downstream of the insertion, while only one of these variants was found at the other populations. These features of variability in the ITS1 region of *C. sinensis* might reflect an adaptation strategy of parasite to environmental conditions, different hosts, and drug treatments.

VARIETY OF VIRUSES AFFECTING VEGETABLE CROPS IN THE FAR EAST

Valentina F. TOLKACH¹, Tatyana I. PLESHAKOVA¹, Nadezhda N. KAKAREKA¹,
Mikhail Yu. SHCHELKANOV^{1,2,3}

¹ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

² Far Eastern Federal University, Vladivostok, Russia

³ Federal Budget Institution of Health "Center for Hygiene and Epidemiology in Primorye Territory", Vladivostok, Russia

Soil and climate conditions in the Southern part of the Far East are favorable for cultivation of vegetable crops. The cultivated plants of this area include cabbages, radishes, tomatoes, cucumbers, peppers, eggplants, carrots, beets, onions, garlic, green and legumes as well as pumpkin, watermelon, and zucchini. All these cultures are largely affected by viral diseases. Epidemiology of viruses depends on availability of vectors, natural and anthropogenic foci and climatic conditions.

Cucumber mosaic virus (*Bromoviridae*, *Cucumovirus*), tobacco mosaic virus (*Virgaviridae*, *Tobamovirus*) and tomato mosaic virus (*Virgaviridae*, *Tobamovirus*) dominate are the most dangerous agents for vegetable plants, especially for the *Solanaceae* and *Cucurbitaceae* crops. Virus infections provoke spotted leaves, deformation, mottle, necrosis of leaves and fruits, and frequent elimination of ovaries. Another member of *Tobamovirus* – green mottle mosaic virus – causes complex damage to pumpkin cultures. In Primorye Territory this virus contaminates cucumber plants in open soil plantings. Tomato aspermy virus (*Bromoviridae*, *Cucumovirus*) causes considerable damage to vegetable crops and seed production. Alpha mosaic virus (*Bromoviridae*, *Alphamovirus*) has a very wide range of host plants including vegetable crops. In Primorye Territory and Amur Region this virus was detected in peas and peppers.

Phytopathological monitoring in the Far East has revealed that cabbages are affected by cauliflower mosaic virus (*Caulimoviridae*, *Caulimovirus*), radish mosaic virus (*Comoviridae*, *Comovirus*), and turnip mosaic virus (*Potyviridae*, *Potyvirus*). Most often, these viruses are registered in the suburbs of Artem and Vladivostok cities as well as near the Ussuriisk urban district. Legumes in the Far East are affected by common and yellow bean mosaic viruses (*Potyviridae*, *Potyvirus*). Several new harmful strains of these pathogens have been identified. Yellow bean mosaic virus was first identified in pumpkins. The prevalence of watermelon mosaic virus (*Potyviridae*, *Potyvirus*) is registered in melons. In the Southern part of the Far East this virus has been first detected in marrows and in pumpkins. Tobacco etch virus (*Potyviridae*, *Potyvirus*) and tobacco ring-spot virus (*Picornavirales*, *Secoviridae*, *Nepovirus*) cause serious damage to pepper crop. In all regions of the Far East yellow onion dwarf virus (*Potyviridae*, *Potyvirus*) and garlic mosaic virus (*Tymovirales*, *Betaflexiviridae*, *Carlavirus*) are the most common being easily transmitted by insect vectors. Symptoms of the diseases are streaky chlorotic

mosaics and cracks on the leaves. We detected these viruses in samples of onion and garlic from Primorye and Khabarovsk Territories, Irkutsk and Novosibirsk Regions.

The study was supported by Russian Foundation for Basic Research, project 8-016-00194_a.

NEMATODE COMMUNITIES IN UPSTREAM AND DOWNSTREAM OF THE DAM ON BA LAI RIVER (MEKONG DELTA, VIETNAM)

Thai T. TRAN¹, Que-Lam Nguyen LE¹, Larisa A. PROZOROVA²,
Xuan Quang NGO¹

¹ *Institute of Tropical Biology, Vietnam Academy of Science and Technology,
Ho Chi Minh City, Vietnam*

² *Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia*

This work focuses to research on ecological effects of dam on meiofauna, especially on nematode communities in the Ba Lai river, Mekong Delta, Vietnam. Abiotic environmental parameters of upstream and downstream river from dam and their effects on nematode communities structure have been investigated. Our results found that physicochemical variables discriminated strongly between upstream (U) and downstream (D) section of Ba Lai dam in terms of pH, total suspended solids (TSS), salinity, concentration of organic components, and heavy metals. Meanwhile, nematode communities structure characteristics such as abundance, diversity, and distribution patterns were indicative of serial discontinuity and strongly differed between section. Addition, density and diversity values of nematodes were significantly negative correlated with organic components and heavy metal (except for Pb), while still positive correlated with salinity and Pb. Nematode community structure strongly discriminated between U and D sides, which can explain the differences in physicochemical variables up- and downstream of the dam.

Based upon nematode characteristics were a integrative and sensitive indicator of dam effects. The co-occurrence inclusion of environmental variables and biological characteristics in multivariable analysis was most comprehensive, powerful for the quantification of dam effects and in the ecological assessment of impacts of other stressors on river ecosystems. This study addressed the impacts of Ba Lai dam on nematode communities, which may lead to more sustainable management strategies.

**CLIMATIC CHANGES AND THEIR LINKS TO GLOBAL PROCESSES
INVESTIGATED THROUGH TREE-RING RECONSTRUCTION
BASED ON *PINUS KORAIENSIS* TREES
FROM THE RUSSIAN FAR EAST (NORTH-EAST ASIA)**

Olga N. UKHVATKINA¹, Alexander M. OMEJKO¹, Pavel V. KRESTOV²,
Anna S. VOZMISHCHEVA², Jan ALTMAN³, Alexander A. ZHMERENETSKY¹,
Tatiana Ya. PETRENKO^{1,4}, Vít PEJCHA³, Tatiana Yu. EPIFANOVA¹

¹ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

² Botanical Garden–Institute, FEB RAS, Vladivostok, Russia

³ Institute of Botany of the Czech Academy of Sciences, Trebon, Czech Republic

⁴ Far Eastern Federal University, Vladivostok, Russia

There are very few studies of Russian Far East climate (e.g., Willes et al., 2014; Jacoby et al., 2004; Shan et al., 2015); moreover, there is an absence of dendrochronological studies for the continental part of Russian Far East. Meanwhile, most of species present in northeastern China, the Korean peninsula and Japan grow in this region. In addition, the distribution areas of these trees often end in the south of the Russian Far East, which increases the climatic sensitivity of plants. Additionally, some parts of the forests in the Russian Far Eastern have not been subjected to human activity for the last 2000–4000 years. This makes it possible to forests extend the studied timespan. In addition, the southern territory of the Russian Far East is sensitive to global climatic changes as it is under the influence of cold air flow from northeastern Asia during the winter and summer monsoons. All of the factors listed above create favorable conditions for dendroclimatic studies.

Mixed forests with Korean pine (*Pinus koraeinsis* Siebold et Zucc.) are the main vegetation type in the study area, and they form an altitudinal belt up to 800 m above sea level. This area is the northeastern limit of the range of Korean pine-broadleaved forests, which are also found in northeastern China (the central part of the range), on the Korean peninsula, and in Japan. The Sikhote-Alin mountain range is one of the few places where significant areas of old-growth Korean pine-broadleaved forest remain. The *Pinus koraiensis* – one of the most long-lived tree species in the north-east Asia forest which has undecayable woods. These allowed us to find preserved wood samples and investigated important climate-growth relationships more than 450 years. In this we present first results of our dendroclimatic research.

The territory of Russian Far East is characterized by a monsoon climate which is determined by the interaction of the Pacific Ocean and the Siberian anticyclone. So, the radial growth of Korean pine in the study region is mainly limited by the pre-growth autumn-winter season temperatures and spring – early summer precipitations. Using the tree-ring width of *Pinus koraiensis*, the mean minimum temperature of the previous August-December has been reconstructed for the southern part of Sikhote-Alin Mountain Range, northeastern Asia, Russia, for

the past 486 years. And also we reconstructed April – June precipitation for the southern – middle of Sikhote-Alin Mountain Range for the past 300 years. These datasets are the first climate reconstructions for this region, and for the first time for northeast Asia, we present a reconstruction with a length exceeding 486 years. Undoubtedly, the results of our research are important for studying the climatic processes that have occurred in the study region and in all of northeastern Asia and for situating them within the scope of global climatic change.

**THE PHYLOGENETIC RELATIONSHIPS
OF THE FAMILY ALLOCREADIIDAE LOOSS, 1902
WITH OTHER REPRESENTATIVES
OF SUPERFAMILY ALLOCREADIOIDEA NICOLL, 1934**

Konstantin S. VAINUTIS

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

This study touches upon the question of systematic position of the family Allocreadiidae within superfamily Allocreadioidea. Allocreadiidae is a family of parasitic flatworms from class Trematoda Rudolphi, 1808, subclass Digenea Carus, 1863. Their life cycle is going through bivalve mollusks (as first intermediate hosts), amphipods, mayflies and stoneflies (as second intermediate hosts), freshwater fishes from different orders of class Actinopterygii and anuran frogs (as definitive hosts). According to the generally accepted classification, superfamily Allocreadioidea includes following families: Opecoelidae Ozaki, 1925; Brachycladiidae Odhner, 1905; Batrachotrematidae Dollfus & Williams, 1966 and Allocreadiidae Looss, 1902. Molecular data, namely 28S rRNA fragment, were used to show actual position of Allocreadiidae within superfamily. Phylogenetic tree showed a significant discrepancy between Allocreadiidae and other families of Allocreadioidea. The molecular-genetic analysis revealed that Allocreadiidae is closely related to the families Gorgoderidae Looss, 1899 and Callodistomidae Odhner, 1910 from superfamily Gorgoderoidea Looss, 1901. That fact was previously noted by Choudhury et al. (2007) and Bakhoum et al. (2017).

VARIETY OF VIRUSES AFFECTING NATURAL FLORA OF NORTH-EASTERN ASIA

Yury G. VOLKOV¹, Nadezhda N. KAKAREKA¹, Zinaida N. KOZLOVSKAYA¹,
Mikhail Yu. SHCHELKANOV^{1,2,3}

¹ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

³ Federal Budget Institution of Health "Center for Hygiene and Epidemiology in Primorye Territory", Vladivostok, Russia.

Viral diseases of wild plant species, which may serve as reservoirs of infection for cultivated plants, have been monitored in the Far East since 1962. Nowadays, more than 200 viruses were documented. Representatives of *Fabaceae* and *Asteraceae* are the most virophilic.

In laboratory studies, using various diagnostic methods, viral etiology has been proven for more than 40 diseases of wild plant species. The study of biological, physical, chemical, and immunological properties of a number of viruses made it possible to identify new viruses and strains belonging to different taxa.

The genus *Potyvirus* is the most widely represented. The foci of the potato Y-virus were registered among *Humulopsis japonica*, *Agrimonia pilosa*, and *Paeonia lactiflora*.

Pathogens, which infect 6 clover species (*Trifolium hybridum*, *T. pratense*, *T. repens*, *T. montanum*, *T. lupinaster*, and *T. montanum*) from various regions of the Far East were identified as potyviruses. Virus from *T. montanum* was identified as a new member of genus *Potyvirus*.

It was believed that the soybean mosaic virus (SMV) from this genus does not have other host plants other than cultivated soybean and that the infection is transmitted via seeds. However, two cases of SMV detection were registered for wild soybean plants (*Glycine ussuriensis*).

Potexvirus, which causes mosaic in *Plantago asiatica*, is represented by two strains (Primorskyi and Sakhalinskyi). In Amur Region, this plant has been diagnosed with a disease caused by a joint infection of a new strain of tobacco mosaic virus, called Amurskyi, and virus potato Y-virus serogroup.

Two bromoviruses were identified: *Vicia unijuga* mosaic virus (MVVU) was represented by four strains (mosaic, necrotic, spotted and Amurskyi); the other – as brome mosaic virus in wild-growing cereals *Elytrigia repens*, and *Spodiopogon sibiricus*. One of the MVVU isolates together with the main virus contained virions of a smaller size (16–17 nm) – presumably of a satellite, which was previously documented only for the tobacco necrosis virus.

Vicia pseudorobus was infected by carlavirus related to the pea streak virus.

Cucumber mosaic virus (CMV) (*Bromoviridae*, *Cucumovirus*) was the most widespread among wild plants: *Arctium lappa*, *Taraxacum officinale*, *Sonchus oleraceus*, and *Filipendula sp.*. CMV was also observed in annual weed plants of *Sigesbekia pubescens*, *Amaranthus caudatus*, and *Galinsoga parviflora*. CMV was

revealed in *Prenanthes tatarinowii*, *Vicia unijuga*, *Arctium lappa*, *Armeniaca sibirica* at the forest edges and among the windbreak.

We identified several diseases of natural flora caused by pathogens from the genus *Nepovirus*: tobacco ringspot virus discovered in *Syringa amur ensis* and *Doellingeria scabra* as well as new *Phryma asiatica* mosaic virus.

A new viral isolate with filamentary particles (1000–1200 × 10–12 nm) was detected in *Vicia unijuga*. It was presumably identified as a member of *Closteroviridae* family.

The study was supported by Russian Foundation for Basic Research, project 8-016-00194_a.

GEOGRAPHICAL AND HOST-SPECIFIC DISTRIBUTION OF THE GENETIC DIVERSITY IN TROGLOTREMATIDS

Anastasiya N. VORONOVA, Galina N. CHELOMINA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Nanophyetiasis is a dangerous zoonotic disease caused by trematodes from the genus *Nanophyetus* Chapin, 1927 (Digenea: Troglotremitidae), widespread in the coastal regions of the Pacific Ocean: North America, the Russian Far East and the Japanese Islands. Despite the wide spread, the medical and veterinary importance of these trematodes, they remain genetically unexplored. To understand the key mechanisms that guide their evolution, for the first time we analyzed the distribution of genetic diversity in *Nanophyetus schikhobalowi* by comparing parasite samples from different river systems and different species of host fish using markers of nuclear (ITS rDNA region) and mitochondrial (*nad1* gene) DNA.

Analysis of the intraspecific genetic diversity of *N. schikhobalowi* revealed two types of variability: geographic and host-specific. The genetic subdivision of parasitic populations between species (or races) of their hosts is known, although differences are often associated with different geographic locations or habitat patterns (Harvell et al., 2002; Johnson et al., 2002; Wang et al., 2006; Sun et al., 2013; Chelomina et al., 2014). The present study is distinguished by the fact that we compared not only individual geographic samples and samples from different hosts, but also samples from different host species in different river systems.

Geographical origin is often associated with genetic differentiation of populations, when there is a decrease in genetic differentiation in spatially close populations and its increase at large geographical distances. This is the simplest model of genetic isolation of populations (isolation by distance, isolation by distances). However, this model did not obtain support in our study; data correspond to the model with isolated groups. According to the Red Queen hypothesis, host-parasite relationships lead to a constant natural selection for adaptation and counter-adaptation, contributing to spatial mosaicism (Van Valen, 1973). The main isolating factor was the water exchange between river systems. The rivers Komissarovka and Ilistaya are parts of the Khanka lake basin, so their systems are not isolated. Likewise, population samples from these rivers are genetically less differentiated (with significant gene flows) than each of them with a sample from Pavlovka (Basin of the Ussuri River) or Komarovka (the Razdolnaya River basin). It is interesting that the population from Ilistaya was the most polymorphic, which can be related both to the history of species invasion and to the general epidemiological situation (Vladimirov et al., 2000; Bulanova et al., 2002). In general, each local population was characterized by the presence of unique ribotypes and haplotypes, indicating the absence of complete panmixia. Population from Pavlovka, has no common ribo- or haplotypes with other rivers. This information is important for predicting

the epidemiological situation in this region and identifying the nanophyetiasis foci.

In the present study, we also showed that pronounced host-specificity of *N. schikhobalowi* is formed under the same conditions of the environment. Host-specific ribo- and haplotypes (i), features in the distribution of nucleotide variability in the sequences of rDNA and mtDNA (ii), low but statistically significant fixation of interpopulation gene flows (iii) were found. These data can be explained by the manifestation of microevolutionary mechanisms of parasite adaptation to the intermediate host-switch. The importance of the influence of hosts on the creation of genetically distinct parasite lines is recognized for a long time, although there is a lack of experimental data. The host spectrum can significantly influence on the intraspecific genetic structure and create barriers to the gene flows (Nadler et al., 2000, McCoy et al., 2001; Johnson et al., 2002, McCoy et al., 2005).

A NEW RECORD OF *BRACHYPSYCHE SIBIRICA* (MARTYNOV, 1924) (INSECTA: TRICHOPTERA, LIMNEPHILIDAE, LIMNEPHILINAE, CHILOSTIGMINI) FROM KAMCHATKA PENINSULA, FAR EAST OF RUSSIA

Tatiyana S. VSHIVKOVA¹, A.A. NIKOLAYEVA²

¹ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

² Kamchatka Research Institute of Fisheries and Oceanography, Petropavlovsk-Kamchatsky, Russia

The genus *Brachypsyche* Schmid, 1952 belonging to the tribe Chilostigmini Schmid, 1955 of the subfamily Limnephilinae Kolenati, 1984, of the family Limnephilidae Kolenati, 1848 is very small and includes only three species: *B. rara* (Martynov, 1914), *B. schmidi* Choe, Kumanski et Woo, 1999, and *B. sibirica* (Martynov, 1924). In Russian Trichoptera fauna, all three species are present [1].

The distribution of *B. rara* is mainly limited by the continental part of East Palaearctic [2], however the species was recorded also from Sakhalin Island [3]. In continental part of East Palaearctic the species is distributed from East Siberia (Irkutsk Region) [4,5], Amur Region [5-7], the southern part of Khabarovsk Territory [4-6] to Primorye Territory [5,6,8,9], and even Sakhalin Island [3]. Outside of Russia, the species is known from Mongolia [10].

B. schmidi is narrowly distributed and limited by continental part of Palaearctic Region of East Palaearctic: Korea Peninsula [11], and Primorye Territory (East Russia): South Primorye, Shkotovka River basin [12].

B. sibirica, among *Brachypsyche* species, is a widely distributed species characterized with a transpalaearctic type of distribution. Its area covers in Russia: the Ural Region, Sayany Mountain Region [1], Far East of Russia: Yakutia (Nelkan), Magadan Region [13], Amur Region [7], Khabarovsk and Primorye Territories, Shantar Islands [6,9,14]. The species is recorded also from the North Europe (Scandinavia) [15-17], and from Japan (Hokkaido) [18,19].

In this paper we record the genus *Brachypsyche* from Kamchatka Peninsula for the first time. The species was collected in the area around the small unnamed stream, a tributary of Kirpichaya River, 31 December 2013, in 18:00, in the imago phase (1♂) on the snow along the ski road at the stream channel; the collector was Nikolayeva A.A. The air temperature at that time was -7°C ; at midday (clear and sunny) no more -5°C . It was the south exposition of the hill slope at 100–150 m from the small stream channel and bog, which is ornamented with willow, alder, and sedges, there are some cold springs there. The species is deposited in the Trichoptera Collection of the International Center of Ecological Monitoring of the Federal Scientific Center of the East Asia Terrestrial Biodiversity FEB RAS, Vladivostok.

In Japan (Hokkaido) the larvae of *B. sibirica* was found in small springs flows,

the adults emerge in late autumn. According to Nozaki and Itou [19], the imago overwinters in the adult stage and can be collected from late autumn to early spring and even on the snow during the winter. The information on collecting adults of *Brachypsyche sibirica* on the snow was also published by Gullefors [16] (for Sweden) and Vshivkova [7] (for Khingansky Nature Reserve, Amur Region of the Russian Far East).

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TAXONOMY AND MOLECULAR PHYLOGENY OF STEMONITIDACEAE (MYXOGASTREA) FROM CHINA

Bo ZHANG, Yu LI

Engineering Research Center of Chinese Ministry of Education for Edible and Medicinal Fungi, Jilin Agricultural University, Changchun, P. R. China

As a special eukarya belonging to the protozoa community, myxogastrea has the characteristics of both fungi and protozoa. Myxogastrea is widely distributed, ranging from temperate zone to tropical zone and even underwater. Stemonitidaceae is a larger family of myxogastrea, including 218 species in 18 genera. In China, a total of 35 species in 12 genera of stemonitidaceae are reported, accounting for only 16% of the quantity reported in the world. Many species were not reported in China, and new resources in this group need to be further explored. By combining with morphological and molecular biological techniques, this study carried out a relatively systematic research on stemonitidaceae in China, listed the distributions of stemonitidaceae in various provincial in China, and carried out analytical research on its ecological characteristics.

More than 1,260 specimens that were newly collected in recent years and specimen collections that were preserved in major Chinese Herbarium were morphologically identified. The identification showed that there were 97 species and 2 varieties of 16 genera of stemonitidaceae in China, including 7 new species, 4 new record genera from China, 57 new record species from China and 2 new record varieties. The main results were as follows: Seven new species: *Comatricha clavicolumella* B. Zhang & Yu Li, *C. macropsora* B. Zhang & Yu Li sp. Nov., *Stemonaria liaoningensis* B. Zhang & Yu Li, *Stemonitis brumalis* B. Zhang & Yu Li, *S. planusis* B. Zhang & Yu Li sp. nov., *S. sichuanensis* B. Zhang & Yu Li, *S. guizhouensis* B. Zhang & Yu Li sp. Nov.; 4 newly recorded genera: *Colloderma* G. Lister, *Elaeomyxa* Hagemst., *Meriderma* Mar. Mey. & Poulain, *Paradiachea* Hertel; 57 newly recorded species and Two new record varieties from CHINA. The identified stemonitidaceae species were described and discussed in detail and the key to genera and species were also herein

A total of 58 SSUrRNA sequences and 30 COI sequences of stemonitidaceae were obtained in this study. Based on these 2 fragments, the phylogenetic analysis of stemonitidaceae was performed using the Most Parsimony and Bayesian analysis.

The phylogenetic analysis results of stemonitidaceae showed that according to the phylogenetic tree, the different species of stemonitidaceae with the same ornamentation of spores were clustered together. In the 7 new species that were named in this paper, 5 new species of SSUrRNA sequences participate in the construction of phylogenetic tree, and they were respectively clustered in corresponding groups, which is consistent with the results of morphological identification.

This study was supported by funds from the National Natural Science Foundation of China (31770012) .

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**A NEW SPECIES IN PHYSARACEAE, *CRATERIUM YICHUNENSIS*,
AND A NEW RECORD FOR *C. DICTYOSPORUM* IN CHINA**

FengYun ZHAO¹, Yu LI¹, Tom HSIANG², Shuyan LIU¹

¹Engineering Research Center of Chinese Ministry of Education for Edible and Medicinal Fungi, Jilin Agricultural University 2888 Xincheng Street, Changchun City, P. R. China

²Environmental Sciences, University of Guelph, Guelph, Ontario, Canada, N1G 2W1

A new species, *Craterium yichunensis*, and a new record for *C. dictyosporum* are described and illustrated. Both of them were found in Heilongjiang Province, China. *Craterium yichunensis* differs from all currently described species of *Craterium* in having sessile sporocarps with a thick lid whose middle part is more than 100 μm thick, with a yellow membrane covering the cup after lid has fallen off, and having no columella nor pseudocolumella. Both species are also illustrated with scanning electron micrographs.

ACKNOWLEDGEMENTS

This research was supported by a Natural Science and Technology Foundation Project (2014FY210400) awarded to the corresponding author and by111 Project (D17014) awarded to Yu Li.

Session 2

Biodiversity conservation and reproduction of biological resources

**THE ECOLOGICAL STATE OF *CYPRIPEDIUM CALCEOLUM* L.
IN PROTECTED LANDSCAPE "GORNOYE ZADELYE"
OF MARI EL REPUBLIC**

Viktoriya V. ANTROPOVA

Faculty of Soil Science, Lomonosov Moscow State University, Moscow, Russia

Protected landscape "Gornoye Zadelye" of Mari El Republic was established for rare plant species conservation, among which is *Cypripedium calceolum* L. [1]. Soils of the area are primitive sod-carbonate, underlying rock is limestone. Because of it, there is an active extraction of limestone. So there is an intense lime sewage pollution of researched species habitats. But yellow lady's slipper is a calciphil [2], so anthropogenic impacts on its populations are not absolutely negative.

The purpose of the research was to study the ecological state of *Cypripedium calceolum* L. in "Gornoye Zadelye". The following objectives were established: 1 – tracking the dynamics of the number and age structure; 2 – determining the ecological strategy.

The field researches were conducted. Two plots (20×20 m) belong to coniferous forest (spruce mixed with pine): 1 – slope in impact zone; 2 – central part of the area. The parameters for ecological strategy assessment: age structure [3], density and population abundance. The research is based on morphological measurement of above-ground plant parts.

During the research, the plant population has aged. The age index before 2009 remained at the same level: 0.13–0.15, which is typical for young populations with ϕ predominance of pregenerative individuals. The population size was increased (table 1). Our data contradict the literary [2]. It is due to the reserve conditions: limestone coming to the surface and species growing near hiking trail. It creates conditions for seed germination. However, population structure may be affected by the increased anthropogenic impact.

The ecological strategy is defined as violent – the species is well adapted to the local conditions and uses the resources entirely, dominating in habitats.

Table 1. Dynamics of *Cypripedium calceolum* L. population parameters

Parameters	2003	2004	2005	2007	2009	2011	2013	2015
Age index	0,15	0,13	0,15	0,15	0,39	0,34	0,29	0,24
Number (ex.)	146	336	278	305	141	81	194	118

Since 2008 there has been logging damaging *Cypripedium calceolum*. It changed the population: in 2009, the number decreased, the population grew old due to the death of young exemplars. The drought of 2010 further exacerbated the situation: in 2011 the number fell to 81, the population was old too.

In 2013, the number leveled because of vegetative generation (194 exemplars). The age index decreased to 0.29, the population became slightly younger.

In 2015, there were not juvenile exemplars, the population decreased. The age index has fallen – there was a population rejuvenation due to the death of generative plants.

In 2003 – the beginning of the monitoring – there were 25 habitats of researched species, today this number decreased to 12, but the population in these places of growth is kept at a constant level.

Thus, negative anthropogenic factors and climatic crises have a significant impact on the number and age structure of the population *Cypripedium calceolium* L., but the species is quite labile because of the vegetative generation.

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WILDERNESS CONCEPT FOR KAMCHATKA FIRST LANDSCAPE INVENTORY AND OF LARGE INTEGRATED MOUNTAIN AND FOREST ECOSYSTEMS IN CONSERVATION ISSUES

Vladimir N. BOCHARNIKOV

Pacific Geographical Institute FEB RAS, Vladivostok, Russia

Information on the status of biodiversity is needed at the international, federal, regional (administrative-territorial) and local levels, when comparing pressing problems, which are very significant differences, as well as in the degree of availability of necessary information. Obviously, for the preparation of a special inventory and monitoring report, a lot of work is needed, including field studies within the entire territory with appropriate funding and the necessary material resources, specialists and the scale of the work done in the office data processing. It is considering that review results and geographical assessment of the current state of biodiversity and living condition of terrestrial and aquatic animals urgently needs at the regional (Pacific Russia) and local levels (the far-Eastern subjects of the Russian Federation). In this paper examines the conservation status as well as the species diversity, ecological habitats and rare species of animals inhabits Kamchatka. The quantitative faunal characteristics have been mapped throughout the Russian Far East. The article presents the results of the original assessment of the current state of Kamchatka's mountain-forest ecosystems, based on calculations of the new indicator "wild nature". Inventory assessment is performed by means of geoinformation calculation of the degree of anthropogenic disturbance of natural landscapes. The peculiarities of the six largest "off-road" territories of Kamchatka are considered, their significance as habitats of four species of hunting animals is shown, the safety of natural ecosystems of specially protected natural territories and beyond is shown. There are considered and discussed the challenges and main threats to marine-coastal and terrestrial biodiversity. In report is discussed the main reasons for having a negative impact on the conservation of species and ecosystems. It can be noted that, in terms of preservation of the wild nature of Kamchatka, the natural change of altitude belts continues to be well expressed: glacial-nival complexes are replaced by tundra-alpine-meadow complexes, contacting with the belt of cedar stalks, passing down the slopes midlands in the forests of stone birch with high-grass meadows. Relatively high level of natural preservation, or more than half of the impassable territories are still in Kamchatka landscapes of stone pine trees. From quarter to forty-four percent of the original natural area have retained their tundra landscape groups (arcto and mountain tundra, Far Eastern tundra and forest-tundra, stone-birch forests). Less than a quarter remained floodplain, north-taiga and forest-lag groups of types of landscapes. According to main ecosystems are defined and recommend measures, restricted to local management plans of the Pacific Russia to make appropriate satisfaction of public needs for residents.

HOW CAN KOREAN URBANISED LANDSCAPES PRESERVE AMPHIBIAN BIODIVERSITY?

Amaël BORZÉE

*Department of Life Sciences and Division of EcoScience,
Ewha Womans University, Seoul, Republic of Korea*

The loss of natural habitats due to urban development and encroachment is one of the major threats to species survival for amphibians. Since the Neolithic Agricultural Revolution, humans have largely settled in lowlands, the primary breeding habitat for a majority of amphibian species. This trend continues nowadays, culminating in metropolises built on land that were once wetlands. There is however a small subset of species that manages to take advantage of human activities through wetland agriculture, *i.e.* rice paddies. In the Republic of Korea, rice production started *circa* 5500 BC, and now covers a significant surface of the territory. The benefits of rice paddies are multiple, and among others they provide constant flooded environments for larvae development, and continuous habitats resulting in decreased competition and predation pressure. Consequently, species can take advantage of anthropogenically modified environments to increase their breeding output and survival. Modified environments include rice paddies, exploited by *Hylid* and *Pelophylax* species, reservoirs used to flood rice paddies used by *Bufo spp.*, but also dykes and ditches providing water to rice paddies exploited by *Rana* and *Hynobius spp.* Although beneficial for some species, artificial wetlands negatively impact others. For instance, *Dryophytes suweonensis* saw the totality of its natural breeding habitat transformed, although this is double-sided as the species is now also distributed on agricultural lands reclaimed from inter-tidal flats. Another example of a species that may not benefit from rice paddy is *Hynobius leechii*. Because of the higher connectivity of rice paddies for irrigation, predators are present in larger numbers and feed on eggs. Species breeding in rice paddies also have to adapt to agricultural practices, and as a result Hylids have been found to start breeding once rice paddies have been flooded and planted. Finally, due to their agricultural purposes, rice paddies have never been listed as protected areas, despite species only occurring in this modified habitat, and they are currently being transformed into dry lands for higher benefits than the sale of rice.

EAST RUSSIA INTEGRATIVE HERBAL MEDICINE/PHYTOTHERAPY AND DNA DATABASE

Kostantin A. DROZDOV^{1,2}, Olga D. DEMINA²

¹ *G.B. Elyakov Pacific Institute of Bioorganic Chemistry, FEB RAS., Vladivostok, Russia*

² *Far Eastern Federal University, Vladivostok, Russia*

Land plants can be considered as the main source for the creation of new pharmacological substances [1]. First, there is a centuries-old experience of using plants in the form of drugs. In this regard, you can narrow down the search for potentially useful plants, moreover, immediately determine the range of diseases in which it is advisable to use substances from concrete plant. Secondly, an important factor is that humankind has a great experience in the cultivation of plants, which makes it possible rapidly increase production of necessary plants in an artificial state without the withdrawal of wild plants from the nature habitats.

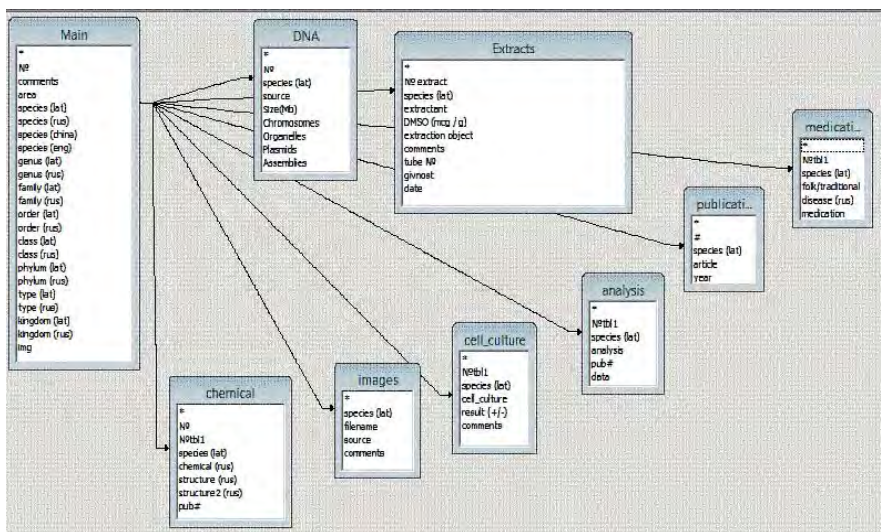
Meanwhile, despite the achievements on the use of plants as raw materials for the production of pharmacological preparations, this resource is not used as effectively as it could be. One of the reasons for this state of affairs is that, the academic science (such as plant biology, biochemistry, modern medicine, etc.) and traditional medicine, based on the historical experience of using plants, develop in different directions and do not intersect sufficiently. It is quite difficult to obtain a complete data on plant biology and the experience of its use in clinical and traditional medicine because, as it was noted, clinical and traditional medicine are usually not related to each other, and very often are opposed to each other [2, 3].

To overcome these difficulties we proposed to create an automated database that will include comprehensive information about the East Russia plant objects of interest: information about the chemicals detected in plant, systematic, DNA, distributional, ecological data, knowledge about the use the plant in traditional and clinical medicine, as well as references of any publications connected to this plant facility.

The available databases are only partly consistent with the objectives [4, 5]. The most similar in ideology is the Database of African plants – «SANCDDB: South African Natural Composition Database» [6], but it is not suitable for the systematization of laboratory data.

The proposed The East Russia Integrative Herbal Medicine/Phytotherapy and DNA Database will be useful source of information for biochemists, pharmacologists, physicians, genetics, helpful for developing of relationships between modern and traditional medicine, and lead to further discovery of drugs from natural plant resources of East Russia region.

DATABASE STRUCTURE



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**THE DIVERSITY AND TRANSCRIPTIONAL RESPONSES
OF THE CALCIUM SENSOR GENES
OF WILD-GROWING GRAPEVINE *VITIS AMURENSIS* RUPR.**

Aleksandra S. DUBROVINA¹, Olga A. ALEYNOVA¹, Andrey R. SUPRUN^{1,2},
Zlata V. OGNEVA¹, Konstantin V. KISELEV¹

¹ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

² Department of Biodiversity, Far Eastern Federal University, Vladivostok, Russia

Since widely cultivated grapevines are susceptible to abiotic stresses, including extreme temperatures, salinity, or drought, it is of special interest to investigate the mechanisms involved in the abiotic stress tolerance in a wild grape species. The Amur grape, *Vitis amurensis* Rupr., a wild grapevine species originating from East Asia, is characterized by its remarkable adaptive potential and a high level of resistance against adverse environmental conditions. Therefore, studying the molecular and genetic mechanisms of the wild grapevine abiotic stress adaptation is relevant today.

Under environmental stress conditions, calcium enters cell cytoplasm and binds intramolecular sites of calcium sensor proteins. This leads to changed conformation of calcium sensor proteins and subsequent signal transmission due to protein-protein interactions and protein phosphorylation. Calcium sensor proteins, including calmodulin (CaM), calmodulin-like proteins (CML), calcium-dependent protein kinases (CDPKs), and some others, are known to mediate plant acclimation to various environmental changes. The specific functions and properties of most grape calcium sensors have not been clarified. The main purpose of this study is to investigate the roles of transcription of *CaM* and *CML* genes in *V. amurensis* abiotic stress adaptation. Since the wild grapevine *Vitis amurensis* Rupr. is selected as a model system, this project could also contribute to understanding the molecular and genetic bases of the high resistance of *V. amurensis* to abiotic stresses.

In this study, we cloned and sequenced full-length coding cDNA sequences of 10 *VaCaM* and 20 *VaCML* transcripts. Among the *VaCaM* and *VaCML* transcripts, all *CaM* and *CML* were novel for Vitaceae. We performed the analysis of *VaCaM* and *VaCML* gene expression in *V. amurensis* Rupr. under different abiotic stress conditions. The effect of high-salt, high-mannitol, desiccation, low temperature, and high temperature stress conditions on expression of *VaCaM* and *VaCML* genes in healthy *V. amurensis* cuttings was studied using real-time PCR and DNA sequencing. According to our data, transcription of more than 10 *VaCaM* and *VaCML* genes of *V. amurensis* was induced under different abiotic stress treatment conditions, including water deficit, high salinity, as well as high mannitol and temperature stresses. The data obtained also revealed the presence of several alternatively spliced transcripts of *VaCaMs*, which could expand the diversity of *V. amurensis* responses to abiotic stress. The data demonstrate that the stress-responsive *Va-*

CaM and *VaCML* genes of *V. amurensis* may be implicated in abiotic stress signaling and potentially contribute to the high-level resistance of *V. amurensis* to adverse environmental conditions.

This work was supported by the Russian Foundation for Basic Research, project no. 18-04-00284-a.

**THE PERSPECTIVE OF RESTORATION OF THE WILD
MANCHURIAN APRICOT (*ARMENIACA MANDSHURICA* (MAXIM.)
KOSTINA) IN THE PRIMORYE TERRITORY BY SEED RENEWAL**

Tatyana Yu. EPIFANOVA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

In the modern world, the problem of preserving the biodiversity of rare relict plants continues to be relevant. One of the most important tasks of reforestation of such plants in the Russia is the transition to a breeding-genetic basis. For the renewal of rare Far Eastern plants, the seed renewal is of great importance.

Taking into account the fact that the north-eastern border of the Manchurian apricot (*Armeniaca mandshurica* (Maxim.) Kostina.) range lies in the Southern Primorye, the protection of the gene pool of this species is of international importance. In natural plantations with manchurian apricot, most specimens of this rare and beautifully flowering species are severely damaged, the status of the species is estimated as weakened.

However, the fruiting periodicity of some species, including the Manchurian apricot (MA), can create certain difficulties in the annual provision of tree nurseries with full seeds. The development of modern technologies for long-term seed storage should be based on knowledge of the biological characteristics of seeds and optimal conditions, under which the minimum loss of their viability is noted.

MA is included in the list of rare and endangered plants of the Russian Federation (Red Book, 1975, Red Data Book of the Primorye Territory, 2004, Red Data Book of the Russian Federation, 2008), but is now largely unprotected. Communities with its participation are exposed to natural forest destructive factors (primarily forest fires), which lead to a reduction in the areas occupied by this species.

Over the past 10 years, natural plantations with apricots have significantly decreased, with the most productive areas disappearing first. Most of them, each year suffer from agricultural fires. Low resource potential and environmental protection functions transform these plantations into small, low productive, isolated islands with the participation of MA in the composition of up to 1 unit, which practically fall out of the plantations.

To preserve the populations of this valuable species, it is necessary to promote its natural renewal in natural conditions. To create natural monuments, genetic reserves and forest seed plantations. Use existing modern methods of introduction into culture in vitro and banks of long-term storage of seeds.

The purpose of this work is to study the peculiarities of seed renewal and the preparation of seeds of wild apricot for sowing. At the same time, the quality and degree of maturity of the seeds, humidity, temperature and aeration during storage, the maximum duration of their storage and the conditions under which they retain their viability were determined. Studies have been carried out to study

the features of presowing seed preparation (Terms and conditions of stratification, depth and density of sowing, the degree of damage to rodents, dependence on the method and timing of sowing and ways to protect against rodents).

The experiments were performed in five replicates, from 1998 to 2013, in the nursery FGU Training and Experimental Forestry "Far East" FGOU VPO "PGSHA" (Ussuriisk district). To establish the optimal time for stratification, 1.5 thousand seeds of MA were used.

According to the results of research, the good quality of apricot seeds is 94–96 %. Optimal way of storing apricot seeds can be considered hermetically sealed and refrigerated glass containers. In this case, the shelf life at which the seeds of the apricot remain viable, can be extended to 3 years or more. Pre-unprepared and seeded directly into the ground, they only grow in a year, sprouts are rare, because most of the seeds are destroyed by rodents. Winter stratification of apricot seeds is preferably at a constant temperature of + 3–5 °C and in basements. When stratifying the seeds of apricot in sawdust of hardwoods, they often rot (the safety of seeds averaged 88 %). Stratification in the sand gave higher results (up to 97 %).

The duration of stratification of freshly picked apricot seeds was shown to be 40 days. Stratified apricot seeds were sown in the spring, in late April, on the ridges. Autumn stratification and seeding of apricot seeds in conditions of southern Primorye without measures of protection from rodents do not give positive results. When growing seedlings of apricot, one of the decisive factors is the density of sowing. The seeding rate is recommended around 25 grams per 1 running meter, which corresponds to 35 seeds, the depth of sowing is 4 cm. To use apricot for increasing the productivity of the forests of the Southern Primorye, it is necessary to organize permanent seed-growing plots to collect seeds in the best natural plantations with apricots. For reproduction of highly productive forms, it is recommended to select apricot trees with valuable hereditary properties (beautiful crown shape, large fruits with good taste qualities, etc.). The most suitable forest seed plots, in our opinion, can be plantings located in the upper reaches of the rivers Komissarovka, Studenaya, Granitnaya, Ilistaya, and also in the vicinity of the villages Borisovka, Monakino, Vassianovka.

Timely and high-quality implementation of the recommended measures will contribute to increasing the productivity of forests and their soil protection functions, and will also allow preserving and improving the gene pool of Manchurian Apricot.

ANALYSIS OF THE COPPICE RESUMPTION OF MANCHURIAN APRICOT NATURAL HABITATS IN THE SOUTH OF THE FAR EAST

Tatyana Yu. EPIFANOVA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

There is an opinion that the quality of wood, durability, fruit bearing and other indicators of sprout-origin trees are much lower than those of seed-origin ones. At the same time, the coppicing has obvious benefits: (a) after harvesting of trees with trunks crooked or destroyed with pests or diseases, new healthy trees able to grow and develop can be obtained from stump coppice; (b) new coppice shoots quickly form a new stand by restraining the development of undesirable grass and shrub vegetation.

One of the most popular ornamental, melliferous and fruit tree of Primorye is the Manchurian Apricot – *Armeniaca mandshurica* (Maxim.) Kostina. It is classified as a species with a reduced area and is included in the list of rare and endangered plants of the Russian Federation (Red Book, 1975).

In the spring of 2015, the study of the coppice ability of apricot in the natural habitat was carried out on 3 temporary trial plots in Ussuriisk district of the Primorye Territory. The first site (PP 1–2015, 2.5 ha) was a burned-out forest formed as a result of grassland fire of 2014. It was located in the vicinity of Kuguki village. The forest type was Oak–Rhododendron.

The second plot (PP 2–2015, 1.5 ha) was located on the southwestern slope of the Ostraya Hill in the vicinity of the village Borisovka. The forest type was mainly Oak–Lespedeza, significantly affected by a grassland fire in the spring of 2013.

The third site (PP 5–2015, 3.0 ha) was a forest shelter belt on the right side of Vladivostok–Khabarovsk railroad (9218 km). The site burns down every year.

On each site, 25 apricot stumps of different diameters were selected for study. During the summer of 2015, shoots appeared on the stumps were counted and their height and diameter were measured. The number of sprouts on the stump was shown to depend on the age and diameter of the felled tree. The maximum number of viable shoots per one stump was 32. Two periods of growth in height were observed during the vegetation period – in May and in July.

The average height of one-year old shoots was 104 cm in the Oak–Lespedeza forest and 97 cm in Oak–Rhododendron forest. The height of some specimens was 2 m. In the forest shelter belt, only 22 stumps of apricot of 25 had shoots. On the last plot, the average number of live shoots on 1 stump was 13, which is higher than in natural stands; this is probably due to more favorable growth conditions.

According to our study, the Manchurian Apricot can be safely attributed to breeds with good coppice renewal. Starting from early age, apricot is able to give shoots if the trunk is damaged. Moreover, the tree growth of sprout-origin apricot is 3–4 times more intensive than the growth of seed-origin apricot, and the height of 5–year old tree can achieve 3 meters or higher.

BARLEY STRIPE MOSAIC VIRUS (*VIRGAVIRIDAE*, *HORDEIVIRUS*) AS BIOLOGICAL THREAT FOR AGRICULTURAL CROP IN THE FAR EAST

Alena V. GAPEKA¹, Nadezhda N. KAKAREKA¹, Yury G. VOLKOV¹,
Mikhail V. SAPOTSKIY¹, Mikhail Yu. SHCHELKANOV^{1,2,3}

¹ Federal Scientific Center of East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

² Far Eastern Federal University, Vladivostok, Russia

³ Federal Budget Institution of Health "Center for Hygiene and Epidemiology in Primorye Territory", Vladivostok, Russia

The grain production is the basic and obvious economic purpose of agriculture. Rice, oats, winter crops, maize (grain and feed), spring wheat and spring barley are grown in Russian Far East regions. Maize, spring wheat and spring barley are dominant crops in the structure of the cereal production. So, the amount of areas under crop of maize has increased during the last fifteen years from 3.11 thousand hectares in 2005 to 38 thousand hectares in 2018 only in Primorye Territory.

It is well known the barley stripe mosaic virus (BSMV) (*Virgaviridae*, *Hordeivirus*) is ubiquitous. It is very strong disease that takes damage of cereals crop and decrease of its yield. Wheat, barley, wild oats are its natural hosts. Our researches has shown that BSMV is widely distributed in the Far East. For example, in Primorsky krai the occurrence of BSMV was 3 % for the spring wheat and the spring barley even in the epidemiologically successful years. It has been established that winter crops are more sensitive to this infection than spring crops. In addition, in 2014 we found a disease of corn which was called «mosaic chlorotic stripe disease» and we determined the infectious nature of the pathogen. In further researches we proved that the disease is etiologically associated with BSMV. Thus, we first showed that corn is affected by BSMV in vivo and can be attributed to host plants of BSMV.

We conducted work to identify susceptible host plants of this virus. It was shown that this virus affects wild monocotyledonous plants – *Elytrigia repens*, *Setaria pumila*, and on some wild dicotyledonous plants, for example *Chenopodium quinoa*. Taking into account that BSMV is transmitted by seeds and mechanical damage, it persists for a long time in the vegetative parts of infected plants, we can be said that these plants are excellent source of this infection. BSMV has been classified as a quarantine pest in the USA and Canada. The European and Mediterranean Plant Protection Organization introduced this virus into the list recommended for quarantine regulation (List A2).

The prevalence of wild host-plants of the virus and the level of contamination of cereal crops in the Far East could be causes of virus outbreaks. Under certain conditions this dangerous virus can become a threat not only to producers of agricultural products, but also to plants of phytocoenosis among of them there are unique endemic plants. Thus BSMV is a dangerous pathogen to the biological diversity of the natural recourses in the Far East.

SULFATED GALACTANS FROM *RHODOPHYTA* – A PERSPECTIVE DRUG AGAINST DEMODECOSIS

Ovanes M. GRIGORYAN¹, Tatyana V. MOSKVIN¹, Mariya A. BEGUN¹,
Lidiya F. SKLYAR², Aleksandra A. KALITNIK¹, Elena N. LUBCHENKO⁴,
Svetlana N. BENIOVA^{1,2}, Yury S. KHOTIMCHENKO^{1,5},
Mikhail Yu. SHCHELKANOV^{1,3,5}

¹ Far Eastern Federal University, Vladivostok, Russia

² Regional Clinical Hospital No. 2, Center for the Prevention and Control of AIDS and
Infectious Diseases, Vladivostok, Russia

³ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

⁴ Regional State Budget Institution "Veterinary Anti-Epizootic Service in Primorye Territory",
Vladivostok, Russia

⁵ National Scientific Center of Marine Biology, Vladivostok, Russia.

Etiology of demodicosis is associated with invasion into the skin and intense proliferation of mites belonging the genus (eyelash mites) from the family *Demodicidae* (*Trombidiformes*). Nowadays, about 140 species of *Demodex* mites are described that parasitize on various taxonomic groups of mammals from rodents to higher primates. One could list the great veterinary importance of *D. canis* (including two morphological forms: *D. canis cornei* and *D. canis injai*) for dogs; *D. cati*, *D. gatoi* and *Demodex* sp. (the last species has not yet received a scientific name) – for cats; *D. musculi* – for mice (especially in crowded conditions in vivariums); *D. folliculorum* and *D. brevis* – for humans. Immune deficiencies in humans – especially human immunodeficiency virus (HIV) infection – significantly contributes to the development of the clinical picture of demodecosis. Moreover, dermatological manifestations in HIV infection are markers of progression of the underlying disease.

Treatment of demodicosis is usually based on the use of acaricidal drugs of general effect both orally and externally. However, *Demodex* mites have a thick three-layer cuticle, therefore, antiparasitic preparations of contact action are extremely inefficient, and increasing the dose means increasing toxicity including for skin cells.

The way out can be polysaccharides of a structure unusual for terrestrial animals – e.g. sulfated galactans (class of sulfated polysaccharides) from red algae (*Rhodophyta*) consisting of partially sulphated residues of β -D-galactose and its derivatives connected with alternating α -1,3- and β -1,4-glycosidic chemical bond. Since *Demodex* mites feed on fat secretions, when eating such polysaccharides applied externally, they will be "etched" because of difficulties in digestion.

We conducted a set of experiments on the models of laboratory mice infected by *D. musculi* and dogs infected by *D. canis* using different fractions of sulfated galactans as external agent (1 μ g/ml). After 16 days, evaluating the results of the experiment, we noted the excellent effectiveness of sulfated polysaccharides of

red algae.

Experiments on laboratory mice using *Demodex musculi* suggest the effectiveness of sulfated galactans from red algae in relation to human *D. folliculorum* and *D. brevis*.

RUSSIAN COLLECTION OF VIRUSES FROM EAST ASIA AS AN ELEMENT OF BIOLOGICAL SAFETY ENSURING

Nadezhda N. KAKAREKA¹, Yury G. VOLKOV¹, Valentina F. TOLKACH¹,
Mikhail Yu. SHCHELKANOV^{1,2,3}

¹ *Federal Scientific Center of the East Asia Terrestrial Biodiversity FEB RAS, Vladivostok, Russia*

² *Far Eastern Federal University, Vladivostok, Russia*

³ *Federal Budget Institution of Health "Center for Hygiene and Epidemiology in Primorye Territory", Vladivostok, Russia.*

Viruses are one of the important factors that reduce resistance to adverse effects as well as productivity of animals and cultivated and wild plants. Previous experience of development of natural resources and recreational potential of the Far East reveals the threat of challenging dangerous natural focal diseases. It is revealed that pathogens of a number of diseases circulate in natural conditions and when cultivated plant and animal species are introduced into the natural foci. It results in considerable potential threats to biological safety in the Far East.

Successful large-scale Program for monitoring of natural focus of humans, animals and plants diseases was conducted in the former USSR. Related methodological approaches were developed to become traditional tools of scientific and methodological support for the biological safety of all developed countries. During the implementation of Soviet programs to survey biological diversity of terrestrial ecosystems, new unique viruses were discovered in the Far East.

Russian Collection of viruses from East Asia was established in the 2017 on the base of the Laboratory of Virology of the FSC 'Biodiversity' FEB RAS. The purpose of the collection is the long-term preservation of viral strains in order to trace the modern evolution of East Asian microbiota, improving of the quality and transparency of scientific research in microbiology, and analyzing the biological properties of viral strains to select candidate samples for establishment of test-systems. Strains of phytoviruses identified since 1962 form the core of the collection. It has been revealed that almost all cultural plants and all wild flora are affected by phytopathogenic viruses. The Laboratory of Virology has been developing and implementing immunochemical identification of Far Eastern phytoviruses for many years.

Nowadays, current tasks of the Collection include ensuring the sustainable development of the Far East in accordance with Russian Government resolutions. So, there is an urgent need to resume large-scale studies of virus natural foci in the region in the context of the complex problem of the biological diversity of terrestrial ecosystems. This task will allow timely detection of threats to the development of epiphytotic, epizootic and epidemics, promptly deploy preventive actions and measures to reduce the level of adverse consequences that can affect the sustainable development of the Russian Federation. Russian collection of viruses from East Asia should become an integral element of these investigations.

CULTIVATION OF *LENTINULA EDODES* ON SAWDUST OF CONIFEROUS TREES

Pavel KOMIN

Primorskaya State Academy of Agriculture, Ussuriisk, Russia

Shiitake mushroom is cultivated for over 2000 years. In the wild, the mushroom grows in Japan, China, Korea, southern Primorye, Khabarovsk Territory, Sakhalin and Kunashir islands. Shiitake mushroom is listed in the Red Book of the Primorye Territory, what forbids to harvest it and export abroad. We aimed to elaborate the cultivation technology of *Lentinula edodes* on softwoods sawdust in the Primorye Territory.

First of all, the technology of the substrate production from fresh sawdust was developed. Sawdust was scattered in layer of 1–1.5 cm and dried under sun for 7 hours daily during one month. Then sawdust was autoclaved for 12 hours at 1.5 atmospheres and 128 °C.

For cultivation two types of substrate were used: (1) sawdust only and (2) sawdust with sugar addition (25 g/1 kg). The substrate blocks were inoculated with a wild strain of shiitake mushroom on June 15, 2017. Mycelia started to spread in substrate blocks (2) in 5 days and in substrate blocks (1) in 10 days after inoculation. Favorable conditions for ripening were a temperature of 20–25 °C and humidity below 75 %. The faster ripening was observed on substrate (2), while the primordia appeared on both substrates simultaneously on day 53. Favorable conditions for fruiting were temperature 10–18 °C and humidity 78–95 %.

After harvesting the first flush, the substrate blocks were soaked in cold water for 24 hours. The second flush occurred after about one month. The number and size of mushrooms produced depended directly on the substrate block mass – more block, more mushrooms.

Thus, sawdust of coniferous trees can be widely used as a substrate for the shiitake cultivation.

THE CURRENT STATE OF DYBOWSKI'S FROG FARMING IN CHINA AND RUSSIA

Irina V. MASLOVA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Dybowski's frog (*Rana dybowskii* Guenther, 1876) inhabits the Russian Far East, the southeast of East Siberia, Korea, and Eastern China.

This amphibian has never been in demand in the Russian economy, although it has long been actively collected and used in the PRC by the pharmaceutical, cosmetology and food industries. Collection of females is a priority, since it is their reproductive organs that are used in the treatment of post-stroke states, hypertension, thrombosis, diabetes, atherosclerosis, etc. At the end of the last century, China faced a critical situation with the frog natural resources because of its active uncontrolled capture. There was an urgent need to restore the number of the Far Eastern frog and the transition to its industrial breeding. Since the end of the 20th century, considerable commercial capital has been invested in industrial breeding of the species in China and strong state support has been provided (Liu Renjie et al., 2014). Specialists of the North–Eastern Forestry University (Harbin) developed and published in 1998 the technology of breeding Dybowski's frog (Zhao W.G. et al., 1998), and 152 semi-open farms for its breeding were operated in North–East China by 2007 (Liu Xin et al., 2007).

But, despite the active development of numerous farms in China, a sharp decline in its numbers occurs in 60–70 % of the key areas of its distribution. This is due to several reasons, among them 1) reduction of forest areas (from 79.8 % in 1980 to 58 % in 2007); 2) the environmental pollution and anthropogenic impact; 3) capture of most roe, tadpoles and frogs from the wild; 4) low population recovery rate; 5) backward technologies on frog farms; 6) при возросшей рыночной цене преследование многими фермерами только непосредственных интересов; 7) farmers' calculations mainly on profits from catching wild frogs; 8) a low culture of the frog collectors, gathering everything, including small females. Dybowski's frog population has decreased by 21.5 % compared with the results of the previous national survey on resource stocks (1990's) (Liu Renjie et al., 2014; Liu Xin et al., 2007).

A unique situation has developed on the southern Far East of the Russian Federation, when a number of natural resources began to be withdrawn on a mass scale. Under Russian legislation, these resources are not the commercial species. It, like other amphibians, is not mentioned either in the Federal Law of 24.07.2009 N 209-FZ «On hunting and on the conservation of hunting resources and on the introduction of amendments to certain legislative acts of the Russian Federation», nor in the Federal Law of 20.12.2004 N 166-FZ «On fisheries and conservation of aquatic biological resources».

Unlike other vertebrate groups, amphibians have until now been least

covered by an integrated resource assessment and rational use. So in the database «Biological Resources of the Russian Federation» (<http://www.sevin.ru/bioresrus/classification/animals/vertebrates.html>) there is a concise definition in relation to this class of vertebrates: «The economic significance of amphibians is small.» The resources of Dybowski's frogs in the Russian Far East have not been evaluated. But they are highly demanded components of pharmacological drugs in East Asia, and primarily in China. So, mass poaching of Dybowski's frog started with the purpose of smuggling out (Lyapustin, 2015). This leads to a drop in the number of its natural populations and to large-scale and unpredictable violations of the ecological balance in natural communities.

Starting from 1998–1999 Chinese citizens began to make attempts to organize frog farms in the south of the Russian Far East. But in fact, almost all farms became a «cover» for poaching business. The functioning of farms for the cultivation and harvesting of the Far Eastern frog in the Russian Far East will constantly come into conflict with environmental legislation until two main tasks are fulfilled:

(a) development and approval of the regulatory and legislative framework for the use of amphibians as an object of breeding, fishing and export;

(b) the development of a state program for the rational use of amphibians, based on a cadastral assessment of amphibians (current location, abundance, level and nature of its changes, range structure, reproduction potential, role in the ecosystem formation).

Taking into account the problems that arose in China when breeding frogs, the Department for the Protection, Control and Management of Wildlife Uses of the Primorye Territory should exercise caution when issuing permits for breeding amphibians and when determining the allowable volumes of their capture from the wild.

FEATURES OF MICROPROPAGATION OF THE *ANDROMEDA POLIFOLIA* L.

Anastasiya V. MICHEEVA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

One of the most dangerous trends in modern ecosystem dynamics is the reduction of biological diversity, including the reduction of species diversity as a result of human economic activity. The main reasons for the species extinction are destruction and alteration of biotopes, increased exploitation such groups of useful plants as decorative, medicinal and other, as well as general pollution of the habitat. Conservation of plant biodiversity is currently carried out using modern methods of introduction, including clonal micropropagation, notably asexual reproduction of plants in tissue and cell culture. In this case, the resulting plants are identical to the original specimen. In contrast to herbaceous plants, woody plants are more difficult objects for cultivation *in vitro* as they are characterized by slow growth and problems with the roots formation. In addition, they have a large number of secondary compounds oxidizing and inhibiting cell division and growth in isolated tissues, that leads to the death of the primary explant or decreases an ability of woody plants tissues to regenerate the adventitious buds.

Bog-rosemary (*Andromeda polifolia* L.) is an evergreen, small shrub with pink racemose inflorescences at the ends of branches. In addition to the highly appreciated decorative attractiveness, young shoots are widely used in folk medicine. It is obvious the necessity to increase the production of planting material of this valuable culture, which determined the purpose of our study – the development of effective techniques for clonal micropropagation of *Andromeda polifolia*.

As primary explants, cuttings of shoots of the current year with 1–2 axillary (lateral) buds were used. Sterilization was carried out according to a conventional method. After sterilization, the explants were placed vertically on a growth medium with vitamins, macro- and microsals according to WPM to induce shoot formation. As phytohormones, 2-isopentenyladenine and 3-indolylacetic acid were used. For rooting the process, micro-shoots from 0.8 to 1.0 cm in length were transplanted to rooting medium with the addition of indolyl-3-butyric acid.

First axillary buds developed on primary explants were marked in 4 weeks of cultivation on a growth medium, and the beginning of the formation of multiple shoot were recorded in 7 months. Multiple shoot induction is a process when the explant tissues produce adventitious shoots by activating already existing in the plant meristems. As a result, up to 30 various in size micro-shoots can be formed per a vial.

After transferring to rooting medium, the formation and development of roots occurred within a month. At the stage of adaptation and disembarkation of

plantlets in the soil, the highest percentage of plant decay is observed. Therefore, we selected the conditions for the transfer of microclones into the soil with a gradual regulation of the air and the substrate humidity in the containers. As a result, the survival rate of plantlets was over 90 %.

After a year of cultivation from 20 primary explants, the yield of planting material was 160 vials with shoots (exact amount of microplants per a vial is difficult to assess due to multiple shoots formation).

Thus, the results showed that during a year of cultivation the yield of microplants increased 8 times from the number of initial explants. The plantlets continue to grow successfully in soil, which indicates the suitability of an optimized culture scheme from the sterilization step to the transfer to the soil for the propagation of Bog-rosemary.

RESULTS OF EXPERIMENTS ON MICROCLONAL PROPAGATION THE FAR EASTERN SPECIES OF POPLARS

Tatiana P. OREKHOVA, Olga K. BARKALOVA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Poplar species (*Populus sp.*) have great scientific and economic significance due to small genome size, fast growth, short rotation cycle and ability for vegetative propagation. Investigations on microclonal propagation of *Populus koreana* and *P. maximowiczii* were made in Federal Scientific Center of the East Asia terrestrial biodiversity Far Eastern Branch of Russian Academy of Sciences. The trees such species have height to 30–35 m, a trunk diameter of 1.5 m and grows fast. The warm climate our region is a favorable condition to infect the adult tree by different virus and fungi diseases. Therefore, it was difficult to obtain the sterile explants of poplar. Branches from adult trees were cutting at March 2017 and cultivated in water liquor in the laboratory until young shoots were appeared from the buds. These shoots were used for obtaining adventives regenerates and following propagation in isolated culture. There are many disinfected methods and substances for sterilization explants are used during our investigation. The effective scheme of surface shoot sterilization, ensuring about 90 % disinfested explants, was found. After growing *in vitro* culture on different combinations of mediums (MS, WPM) and hormones, (6-BAP, GA₃) were found to be most efficient and productive combination for shoot proliferation. Multi-shoots appear over 1 month explants cultivated. The proliferated and elongated shoots transferred to 1/2 WPM medium (with half salt composition) and used IAA for rooting. There is a different growth rate (stem height) in our experiments as the result of the somaclonal variability of poplar regenerants. It is concluded that somaclonal variability of poplar can be used for selection of growing poplar plants which necessary for industrial plantations.

SPECIES AND ENVIRONMENT DIVERSITY ON ISLANDS OF PRIMORSKII KRAI: LAND USE IMPACT AND IMPLICATIONS FOR BIODIVERSITY CONSERVATION

Ilona M. RODNIKOVA, Alyona G. KISELYOVA, Kirill S. GANZEI,
Nina F. PSHENICHNIKOVA

Pacific Geographical Institute, FEB RAS, Vladivostok, Russia

Land use has caused biodiversity loss through habitat destruction, fragmentation and environment degradation. Land-use impact appears at the species level through loss of biodiversity, at the landscape level through landscape simplification which alters ecological processes. Thus, to understand land-use effects on biodiversity and environment diversity and to develop conservation strategies identifying the main drivers of diversity in various conditions is needed. The aim of this paper is to review the effects of land use on island geosystems of Primorskii krai with emphasis on species diversity of vascular plants and lichens as well as landscape diversity and soil condition. Islands of Primorskii Krai lie in the southern part of the Russian Far East. More than 40 islands of variable size host unique ecotone communities maintaining high biodiversity. Permanent settlements exist on the largest islands (Russky, Putyatina, Popova, Reyneke), while the rest are involved in some degree of economic activity (tourism, aquaculture, etc.). Several islands are a part of the Far Eastern marine biosphere state nature reserve.

Land area of the study islands is covered with broad-leaved and coniferous-broad-leaved forests. Oak forests without shrub layer dominate on the islands with the highest degree of anthropogenic transformation. Also human transformed area is covered by communities of *Lespedeza bicolor*, *Artemisia gmelinii*, *Miscanthus sinensis*. Several islands maintain great populations of endangered species: *Taxus cuspidata*, *Nelumbo komarovii*, *Kalopanax septemlobus*, *Lilium cernuum*. Lichen species diversity on islands depends on suitable habitat availability, distance from the mainland and human impact degree. Islands with low human impact maintain lichen communities containing rare species.

Dominant oak forests of the islands are mainly formed on highly skeletal typical burosems with general traces of fire damage. Burozems with a shallow and less developed soil profile are found in the upper parts of steep slopes and along narrow slope ridges. Dark burosems with a highly and deeply humified soil profile dominate under high-closed broad-leaved forests with dense herb layer. Dark illuvial-humic burosems are formed under herb-bush-subbush communities under active geochemical sea influence. Soils of forests with coniferous tree species are shallow podzolised burosems. Landscapes of gentle slopes and mid-steep slopes prevail on the largest islands. They are composed of granite and granitoid. The islands are bounded by landscapes of abrasion-denudation cliffs with gravel-pebble sediments with supralittoral and petrophyte vegetation.

Economic activity on the largest islands resulted in simplified landscapes which become obvious if we compare Putyatina isl. and Popova isl. Previously, there was industrial activity on Putyatina isl.; its impact resulted in changes of the landscapes. In spite of a smaller area of current human influence, there are changes in landscape structure, high fragmentation and decrease in biodiversity per area unit. The small islands with less anthropogenic influence have more species diversity of vascular plants and lichens, including rare species per area unit. Small islands are of minor interest in terms of economic activity and have natural protection against anthropogenic influence (inaccessibility), therefore they are “hot spots” of biodiversity. The largest islands subjected to human activity have lower species diversity. Most part of the islands is an erosion vulnerable area. Sheet erosion is a serious problem along roads in human affected areas.

Some small islands maintain native geosystems because of low economical value. These islands should be target areas for conservation efforts.

FAR EASTERN BANK OF BIOLOGICAL MATERIALS AS AN IMPROVEMENT TOOL FOR THE PROTECTION OF BIG CATS (*PANTHERINAE*)

Mikhail Yu. SHCHELKANOV^{1,2}, Sergei V. ARAMILEV³, Pavel V. FOMENKO⁴,
Dmitry V. PANKRATOV⁵, Irina V. GALKINA², Yury G. VOLKOV¹,
Nadezhda N. KAKAREKA¹, Elena N. LUBCHENKO⁶, Irina P. KOROTKOVA⁷,
Yury N. ZHURAVLEV¹

¹ *Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia*

² *Far Eastern Federal University, Vladivostok, Russia*

³ *Autonomous Non-commercial Organization «The “Amur Tiger” Center», Vladivostok, Russia*

³ *Amur Branch of the World Wide Fund for Nature, Vladivostok, Russia*

⁴ *Department for the protection, control and regulation of the use of wildlife objects of the Administration of Primorye Territory, Vladivostok, Russia;*

⁶ *Regional State Budget Institution “Veterinary Anti-Epizootic Service in Primorye Territory”, Vladivostok, Russia;*

⁷ *Primorskaya State Academy of Agriculture, Ussuriisk, Russia;*

The Federal Law «On Introducing Changes to Some Legislative Acts of the Russian Federation» of July 2, 2013 № 150 enacted Art. 258.1 of the Criminal Code of the Russian Federation «Illegal Hunting and Trade of Especially Valuable Wild Animals...» and introduced changes in Art. 226.1 of the Criminal Code of the Russian Federation «Smuggling... of especially valuable wild animals...». Unlike the earlier Art. 258 of Criminal Code of Russian Federation that determined criminal liability for the fact of illegal hunting, which is difficult to prove, Art. 258.1 introduces a new law norm criminalizing even «purchase, storage, transportation, posting and trade of especially valuable wild animals... their parts and derivatives...» (Part 1). A statement was added to Art. 226.1, which determines criminal liability for «illegal transportation across a customs border... of especially valuable wild animals and water biological resources belonging to the list of species included in the Red Book of the Russian Federation and protected by international agreements of the Russian Federation, their parts and derivatives» (Part 1). This significantly increases the effectiveness of nature protection activities. At the same time, the introduction of Art. 258.1 and amendments to Art. 226.1 requires the development of instruments for their implementation in the work of research institutions connected with the examination of bioprobes from especially valuable animals included in the list of the Decree of the Government of the Russian Federation of October 31, 2013 № 978, particularly, big cats living in the Far East – Amur tiger and Far Eastern leopard. The paper discusses four approaches to the legalization of derivatives of big cats kept in research institutions. The authors conclude that the conflict-free enforcement of Art. 226.1 and 258.1 in the process of research work is ensured by a concept of the Far Eastern Bank of Biological Materials developed by stake-

holder institutions. They enumerate the key organizational and legal principles of its functioning that ensure not only the observance of legal norms, but also the transparency, repeatability and reliability of obtained research results and expert conclusions in the interests of protecting big cats in the Far East.

**PROBLEMS OF *TAXUS CUSPIDATA* RESTORATION AND
NATURAL REGENERATION IN THE UDEGE LEGEND NATIONAL
PARK TERRITORY**

Lidiya A. SIBIRINA, Galina A. GLADKOVA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Taxus cuspidata grows in the coniferous and broad-leaved forests of Primorye Territory everywhere, but seldom forms aggregations or groups. This rare Red Book species is protected in all forest reserves and national parks in Prymorye Territory. An investigation was conducted on distribution pattern and population condition and structure of Japanese yews of three areas: Kovalevski Klyuch (about 500 trees on 25 ha, average DBH – 25.9 cm (the highest 80.8 cm), Yakov Klyuch (74 trees on 3 ha, average DBH – 19.7 cm) and Left Mikhaylovsky Klyuch (40 trees on 2 ha, average DBH – 18.6 cm). Unsatisfactory natural regeneration of *Taxus cuspidata* is revealed in all populations – samplings and adults are very poor. Development of protection strategy of *Taxus cuspidata* requires carrying out his inventory in all territory of national park.

PRESENT STATE, URGENT PROBLEMS AND MAIN DIRECTIONS FOR CONSERVATION OF BIODIVERSITY IN DRY LAND

Yury N. ZHURAVLEV

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Pacific adjacent zone of North-Eastern Asia is specified by dynamic climate events, diversity of landscapes, extreme flora' and fauna' richness which fluctuate actively due to speciation and extinction. Economic activity and remedial measures have changed the face of landscapes, however, many of them keep the high biological productivity and species richness. The Tumen River mouth area produced one representative example of territory that joints three neighboring countries which are rich here in biodiversity. More than 1500 species of vessel plants, 400 species of birds, and 15 000 of insect species are represented here creating the unique forest, coastal and mountain communities. Many other important floristic formations are spread through the North-Eastern Asia territory.

In the conditions of economic dynamics many of species have acquired the status of rare or endangered ones. Thus, melioration, built-up areas of the shore and coastal strips cause complications for the migrating birds, particularly, for sandpipers. Special problems were generated as a result of agricultural development of low and wetlands in the former wintering place of migrants. Natural reserves created in Russia, Korea and China along migration routes are unable to solve the problems of wintering. National parks and natural reserves in the China, Korea, Japan and Russia including transboundary protected areas contribute in promoting the migration and reproduction significantly, but the problems of wintering remain.

More promising situation emerges in protection of some predators. A number of Asian countries are engaged in the program of rare big cats' conservations. The problem is tightly connected with the fundamental task of landscape and pyramid of numbers conservation. In relation to Amur tiger and Far Eastern leopard, the governments have reached some important mutual agreements; however, agreements have to be accompanied by multilevel scientific and business support.

New technologies are significant for conservation of the natural habitats and their inhabitants in many ways. The most important are technologies oriented to study the genetic diversity, trophic chains and food resources of rare, endangered and valuable species, to forecast the trends of their dynamics and to offer the ways to prevent the pauperization of their populations. The methods of *in vitro* cultivation of stock materials of economically important plants and animals are significant to lower the industrial pressure on the natural populations and to develop the renewable resources. The cell technologies like cell biomasses production for the secondary metabolites of plants, fungi and some animals as well as technologies of dihaploid and polyploid plant cultivars production, must

to overcome the distrust to biotechnology that is distributed among population in some countries.

Special attention ought to be paid to technologies of reproduction of forest-formed species and to theory of the artificial forest construction. Industrial development generates many threats for biological diversity, however, it bears some approaches to mitigate or even avoid some threats.

Session 3

Soil biodiversity and agriculture

CYANOBACTERIA, ALGAE AND CYANOBACTERIAL–ALGAL COENOSSES BIODIVERSITY IN THE CAVES PRIMORSKIJ VELIKAN AND BELYJ DVOREC (PRIMORYE TERRITORY)

Shamil R. ABDULLIN

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Biodiversity is the important exhaustible resource on the planet (Mirkin, Naumova, 2004; Hanski, 2010). Cyanobacteria and algae inhabit almost all possible habitats on Earth (Algae ..., 1989). But the biodiversity of these organisms and their coenoses have not been studied enough, especially in caves. The aim of this work is to investigate cyanobacteria, algae and cyanobacterial–algal coenoses biodiversity in the caves Primorskij Velikan and Belyj Dvorec (Primorye Territory).

Caves Primorskij Velikan and Belyj Dvorec are situated in Primorye Territory, Partizansky district, lying in limestone. The length of the cave Primorskij Velikan is 540 m, the depth is 93 m, the length of the cave Belyj Dvorec – 120 m. There are temporary lakes and streams in the caves (Bersenev, 1989).

Fourteen samples in the cave Belyj Dvorec and 10 samples in the cave Primorskij Velikan from the ground, the mosses, the surfaces of the walls, water and bottom sediments of watercourses were selected 06–08.11.2009 by standard methods (Abdullin, 2015). The identification of cyanobacteria and algae species composition was performed by light microscopy.

Twenty four species of cyanobacteria and algae, belonging to 4 divisions (Cyanobacteria – 8 species, Bacillariophyta – 6 species, Charophyta – 1 species, Chlorophyta – 9 species), 6 classes, 13 orders, 17 families and 17 genera in the cave Primorskij Velikan and 19 species of cyanobacteria and algae, belonging to 4 divisions (Cyanobacteria – 7 species, Bacillariophyta – 2 species, Ochrophyta – 1 species, Chlorophyta – 9 species), 5 classes, 10 orders, 12 families and 13 genera in the cave Belyj Dvorec have been identified.

In the cave Primorskij Velikan representatives of the class *Cyanophyceae*, families *Oscillatoriaceae* and *Leptolyngbyaceae* and in the cave Belyj Dvorec representatives of the class *Cyanophyceae*, families *Chlorococcaceae* and *Nostocaceae* dominated. On a score of abundance and frequency of species occurrence *Nostoc paludosum* Kütz. ex Born. & Flah. (30 points and 60.0 %) and *Nostoc punctiforme* Har. (28 points and 60.0 %) (Primorskij Velikan) and *Muriella terrestris* J.B. Peters. (35 points and 57.1 %), *Leptolyngbya boryana* (Gom.) Anagn. & Kom. (26 points and 42.9 %), *Nostoc punctiforme* Har. (21 points and 42.9 %) and *Nostoc paludosum* (21 points and 28.6 %) (Belyj Dvorec) prevailed.

Twelve species of cyanobacteria and algae are constant for two studied caves, they are often found in other caves, too (Abdullin, 2015).

In the result of syntaxonomic analysis cyanobacterial–algal coenoses, belonging

to subassociation *Diadesmisetum contentae hantzschietosum amphioxys* Abdullin in Abdullin et Mirkin 2015, associations *Mychonastetum homosphaerae* Abdullin in Abdullin et Mirkin 2015, *Nostocetum punctiformae* Abdullin in Abdullin et Mirkin 2015, *Diadesmisetum contentae* Abdullin in Abdullin et Mirkin 2015, alliances *Mychonastion homosphaerae* Abdullin in Abdullin et Mirkin 2015, *Nostocion punctiformae* Abdullin in Abdullin et Mirkin 2015, *Stichococco–Klebsormidion flaccidi* Abdullin in Abdullin et Mirkin 2015, order *Mychonastetalia homosphaerae* Abdullin in Abdullin et Mirkin 2015 and class *Mychonastetea* Abdullin in Abdullin et Mirkin 2015, were revealed in the cave Primorskij Velikan.

In the cave Belyj Dvorec cyanobacterial–algal coenoses, belonging to associations *Mychonastetum homosphaerae*, *Nostocetum punctiformae*, *Stichococcetum minor* Abdullin in Abdullin et Mirkin 2015, *Phormidietum ambiguum* Abdullin in Abdullin et Mirkin 2015, alliances *Mychonastion homosphaerae*, *Nostocion punctiformae*, *Stichococco–Klebsormidion flaccidi*, order *Mychonastetalia homosphaerae* and class *Mychonastetea*, were determined.

THE COMPOSITION AND PROPERTIES OF BIOCHAR FOR USE ON AGRICULTURAL LAND IN PRIMORYE TERRITORY

Maria BOVSUN, Olga V. NESTEROVA

Department of Soil Science, Far Eastern Federal University, Vladivostok, Russia

The aim of this work is to evaluate the composition and properties of the biochar from *Betula alba* as a potential soil structure in Primorye Territory.

The tasks of this work were:

1. To evaluate the ecological safety of biochar;
2. To evaluate the physico-chemical characteristics of the biochar according to IBI methods;
3. To evaluate the potential suitability of the biochar to improve the water-physical properties of agrozems in Primorye Territory.

The object of the study was the biochar of the company «Krasilov and K», made from wood wastes of the *Betula alba*. Wood waste was produced by pyrolysis at a temperature of 360–380 °C.

The investigated biochar contains 96 % C, from 4.1 % to 6.4 % of ash, from 23.5 % to 26.9 % of volatile compounds, has a medium alkaline reaction (pH = 8.09). According to the elemental composition it contains 0.05 mg/kg Cr, 0.04 mg/kg Ni, 0.14 mg/kg Cu, 0.57 mg/kg Zn, but their concentration does not exceed the MPC. From this it follows that the studied biochar is a high-quality, environmentally friendly and high-carbon product.

According to electron microscopy, the biochar contains 97 % mesopores with a size of 2 µm to 50 µm and 3 % macropores larger than 50 µm. This pore size provides favorable conditions for the life of microorganisms and provides good sorption properties for biochar.

The investigated biochar has a large water-absorbing capacity. Biochar can absorb from 110 % to 242 % moisture from its own weight. The most moisture-intensive fraction is 1 mm.

Soils of the Primorye Territory have poor water-physical properties, acidic reaction of the environment and little humus, so it can be assumed that the application of this biochar on the soils Primorye Territory will help improve water-physical properties, increase the pH, increase the number of microorganisms and reduce carbon loss.

CHANGES IN MICROORGANISM ABUNDANCE INVOLVED IN NITROGEN CYCLE UNDER THE INFLUENCE OF LONG-TERM FERTILIZERS ADDITION

Anastasiya BOYKO

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

The impact of human society on the soil cover is one of the parties to the overall human impact on the environment. As a result of anthropogenic impact on the soil, a gradual change in the processes of soil formation and an ever deeper regulation of the cycles of chemical elements and the transformation of energy in the soil occurs.

The main of natural soil property is fertility. The soil provides plants with all the necessary conditions - elements of nutrition, moisture, oxygen, favorable reaction and concentration of soil solution. However, at present, the natural soils fertility cannot satisfy the growing population food needs. To regulate the balance of nutrients and humus, various doses and ratios of mineral and organic fertilizers are introduced into the soil, which, as a rule, contribute to an increase in the soils productivity, to the improvement of their properties and regimes. However, intensive soil chemicalization makes a tangible contribution to the violation of existing natural links, to soil degradation and pollution.

The increasing fertilizer application volumes necessitate the study of their influence on soil-microbiological processes. The mineral fertilizer use, especially prolonged, can adversely affect the structure of soil microbiocenosis, namely, to reduce the microorganism species diversity, thereby reducing the ability of the soil to self-repair.

Fluctuations in the any microbial community development are a universal indicator for bio-diagnostics and assessment of soil quality and health.

Among the important agricultural microorganisms are allocated microbial groups that participate in the nitrogen cycle, since the nitrogen issue is a global environmental and social problem.

The aim of this work was to assess changes in the number of microorganisms participating in the nitrogen cycle due to the long-term fertilizer use and the soil available nitrogen amount.

The research objects were the agricultural soils of Primorye Territory, Russia involved in long-term experience. Soil samples were selected for work: 1) control, without any addition; 2) with the addition of NPK; 3) with the addition of NPK+ organic fertilizer (NPK+). Sampling was carried out in triplicate.

Determination of the microorganism number participating in the nitrogen cycle (ammonifiers, aminoautotrophs and nitrogen fixers) was carried out by standard methods adopted in soil microbiology, available nitrogen was evaluate by Tyurin.

According to the obtained results, all the microbial groups considered

showed a similar abundance distribution according to the experimental plots. On experimental plots with NPK and NPK+, the ammonifiers content decreased by 6.3 and 3.8 times, respectively, compared with the control. The nitrogen fixer's number decreased in 5.7 and 20 times, respectively. At the same time, the quantity of microorganisms using mineral nitrogen forms increased by 24 and 8.3 times, respectively, compared with the control.

The amount of available nitrogen for NPK and NPK+ plots was reduced by 13 % and 16.5 %, respectively, compared with the control.

Thus, a significant change in the abundance of investigated microbial groups participating in the nitrogen cycle and the content of soil available nitrogen has been established. Available nitrogen reduction in experimental plots is explained by degradation of ammonifying and nitrogen-fixing microflora, as well as an increase in the aminoautotroph quantity due to fertilization. Such changes in the soil microbiocenosis structure contribute to the disturbance of natural soil nitrogen exchange and may further negatively affect the overall mineral soil balance.

CHANGES IN THE PHYSICAL PROPERTIES AND THE HUMUS CONTENT OF FALLOW SOILS IN PRIMORYE TERRITORY

Maksim L. BURDUKOVSKII, Irina V. KISELEVA, Polina A. PEREPELKINA,
Yuliya A. KOSHELEVA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Studies were conducted on the former arable land of the Ussuriysk urban district of the Primorye Territory. These lands were removed from agricultural use in different years. The studied sites were represented by 15, 20, 35 and > 60-years old fallow lands. Aggregate composition of soils and indicators of humus state of fallow lands were studied. These two factors are closely related and are usually considered as key indicators of soil quality. Comparison of indices of fallow soils were carried out with similar soils. but used in agricultural practice (soils of agrochemical experimental station of Primorskii Research Institute of Agriculture).

According to evaluative indicators (Orlov et al., 2004), humus content in studied fallow soils is at the level of 'low' and 'below average' values, and averages from 3.1 to 5.5 %. The increasing humus content was noted with an increase the time spent soil in the fallow state (from 3.7 to 5.5 % in the 20-year old fallow soils).

The degree of humification of organic matter, i.e. the amount of humus substances in the organic matter of all studied fallow soil is at the level of high values (30–38 %). Soil organic matter in fallow soils are closest to their virgin analogs and differ in a number of indices from intensively used in agriculture soils.

The cessation of anthropogenic impact and the overgrowth of former agricultural soils by natural vegetation lead to a change in their structural organization (Karavayeva, Denisenko, 2009). An analysis of the aggregate composition of former arable soils has shown that the content of macroaggregates in the surface layer > 5 mm reliably decreases in the series: plowland – a fallow soil 15 years – a fallow soil 20 years – a fallow soil 35 years.

Agronomically valuable aggregates (AVA) (10–0.25 mm) are considered as they determine the structure of the soil (Shein et al., 2001). The AVA content in the former arable horizon of 15-year old fallow soils is higher by 10 %, compared to the soil used for cultivation.

Soil structure in fallow and arable soils of the current stage of use is rated as «excellent» (>1.50). The maximum value of Soil structure coefficient (Kc) noted in 15-year old fallow soils (7.92–8.81). The value of Kc in more mature soils is lower, probably this is due to the stratification of the arable horizon and the formation of a sod layer on the surface.

The withdrawal of land from agricultural use leads to a gradual restoration of their natural structure, the increasing humus content in the upper part of the soil in comparison with their arable analogues.

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BIODIVERSITY OF ALGAE AND CYANOBACTERIA IN VOLCANIC SOILS NEAR MUTNOVSKY AND GORELY VOLCANOES (KAMCHATKA PENINSULA)

Lira A. GAYSINA¹, M. ELIAŠ², Andrey A. GONTCHAROV³

¹ M. Akmullah Bashkir State Pedagogical University, Ufa, Republic of Bashkortostan, Russia

² University of Ostrava, Ostrava, Czech Republic

³ Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Despite a large number of floristic studies on terrestrial cyanobacteria and algae, information on this ecological group is still lacking for many territories. This problem is particularly acute for remote regions of the North East Asia. Many terrestrial species are tolerant to the extreme ecological conditions, have physiological and genetic adaptations that enhance survival and these organisms could be potentially useful for biotechnology, etc. Flora of Kuril-Kamchatka volcanic arc soils, characterized by physicochemical properties, usually unfavorable for algae and cyanobacteria, is poorly studied (Shtina et al., 1992; Andreeva, 1998) and needs further investigation. There are some data on algae and cyanobacteria from the volcano areas of Kamchatka but mostly these are records of species from thermal springs and aquatic habitats (Nahimovskaja, 1998; Gross, 1999; Kuziakina et al., 2004; Shkurina et al., 2005).

The aim of our study was to explore biodiversity of algae and cyanobacteria in volcano soils near Mutnovsky and Gorely volcanoes, which are to the most active volcanoes of Kamchatka peninsula. Soil samples were taken in July–August 2010 according to the standard methods of soil phycology (Gollerbach, Shtina, 1969). Clonal cultures were isolated by the dilution techniques (Bohunická et al., 2015). Pure cultures in tubes with agar-solidified media were stored at 4 °C in a refrigerator with transparent door at natural daylight regime.

Identification of the species was conducted using a Zeiss Axio Imager A2 microscope with DIC optics, equipped by Axio Vision 4.9 visualization system on magnifications ×400 and ×1000. The relevant taxonomic literature was used (Andreeva, 1998; Anagnostidis, Komárek, 1988; Ettl, 1978; Ettl, Gärtner, 1988, 1995; Komárek, Fott, 1983; Komárek, Anagnostidis, 1999, 2005; Komárek, 2013; Komárek et al., 2014).

Twenty one taxa of eukaryotic algae and cyanobacteria were identified in the soils of Mutnovsky and Gorely volcanoes: Cyanobacteria – 4, Chlorophyta – 15 (Chlorophyceae – 10, Trebouxiophyceae – 5), Streptophyta – 1 and Eustigmatophyceae – 1 (Table).

Among them, *Parietochloris* cf. *cohaerens* (Groover et Bold) Watanabe et Floyd, *Bracteacoccus* cf. *giganteus* Bischoff et Bold and *Leptolyngbya foveolarum* (Rabenhorst ex Gomont) Anagnostidis et Komárek were the most widespread

Table. Species composition of algae and cyanobacteria in soils of Kamchatka peninsula

Species	Samples										
	Mutnovsky volcano					Gorely volcano					
	1	2	6	10	3	4	5	7	8	9	
Cyanobacteria											
<i>Calothrix cf. brevisima</i> G.S.West											
<i>Fischerella cf. major</i> Gomont				+							+
<i>Leptolyngbya foveolarum</i> (Rabenhorst ex Gomont) Anagnostidis et Komárek				+							+
<i>Trichocoleus cf. hospitus</i> (Hansgirg ex Gomont) Anagnostidis	+										
Chlorophyta											
Chlorophyceae											
<i>Bracteacoccus cf. giganteus</i> Bischoff et Bold		+			+						+
<i>Chlamydocapsa cf. lobata</i> Broady				+							
<i>Chlorosarcinopsis</i> sp.				+							
<i>Neocystis</i> sp.1	+										
<i>Neocystis</i> sp.2		+									
<i>Neocystis</i> sp.3						+					
<i>Neocystis</i> sp.4											+
<i>Neocystis</i> sp.5							+				
<i>Coelastrella oocystiformis</i> (Lund) Hegewald & Hanagata							+				
<i>Coelastrella aëroterstrica</i>							+				
Trebouxiophyceae											
<i>Chlorella</i> sp.							+				
<i>Leptosira</i> sp.							+				
<i>Mirmecia</i> sp.							+				
<i>Parietochloris cf. cohaerens</i> (Groover et Bold) Watanabe et Floyd						+					+
<i>Pseudococcomyxa cf. simplex</i> (Mainx) Fott						+					
Streptophyta											
<i>Klebsormidium flaccidum</i> (Kützing) Silva et al.							+				
Eustigmatophyceae											
<i>Eustigmatos magnus</i> (J.B.Peretsen) Hibberd*							+				

species. Earlier *Bracteacoccus* cf. *giganteus* was found in the Primorye Territory (Andreyeva, 1998). *Parietochloris* cf. *cohaerens* has been detected near Golovin volcano on Kuril Islands (Shtina et al., 1992).

In the algal flora of Mutnovsky volcano cosmopolitan and ecologically tolerant species *Pseudococcomyxa* cf. *simplex* (Mainx) Fott, *Klebsormidium flaccidum* (Kützing) Silva et al., cf. *Trichocoleus hospitus* (Hansgirg ex Gomont) Anagnostidis, *Coelastrella aeroterrestica* Tschaike, Gärtner et Kofler, cf. *Fischerella major* Gomont, *Eustigmatos magnus* (J.B.Peretsen) Hibberd and some green algae were detected. In soils of Gorely volcano potentially new to science cyanobacteria, which we tentatively identified as cf. *Calothrix brevissima* West, was found. Very limited number of species in soils of Gorely volcano probably related to the geochemical features of the substrate, especially with high concentrations of Rb, Cs, Ba, Th, U, Nb, Hf and Zr) (Chaschin, 2008).

Some morphologically highly similar isolates of green algae were identified using ITS2 and 18S rRNA sequences. ITS2 sequence of the strain 633-370K1 was almost identical to sequence of the authentic strain *Coelastrella oocystiformis* (Lund) Hegewald & Hanagata SAG 277-1 (JX513887), while sequence of the strain 635-535K10 turned to be highly similar to the sequence of the authentic strain *Coelastrella aeroterrestica* SWK1_2 (JX513879). 18S rRNA sequences of several green algae strains confirmed, that these isolates belong to the genera *Leptosira* Borzi, *Myrmecia* Printz and *Neocystis* Hindák.

Thus, species composition of volcano soils near Mutnovsky and Gorely volcanoes was highly specific and reflects peculiarities of the habitat.

It is supposed that unicelled green algae brought with the dust are among the first colonizers of the new volcanic deposits (Shtina, 1991). However, our data suggest that filamentous green algae and cyanobacteria, as well members of the class Eustigmatophyceae thought to be intolerant to extreme ecological conditions also appear at the early stages of succession.

This study was supported by the Russian Foundation for Basic Research in frame of projects 16-04-01511 a.

SILICA PHYTOLITHS IN THE MEADOW SOILS OF THE MID-AMUR LOWLAND

Aleksandra A. GOLYEVA¹, Lira A. MATYUSHKINA², Galina V. KHARITONOVA²,
Natalia S. KONOVALOVA³

¹ *Geography Institute, RAS, Moscow, Russia*

² *Institute of Water and Ecology Problems, FEB RAS, Khabarovsk, Russia*

³ *Institute of Tectonics and Geophysics, FEB RAS, Khabarovsk, Russia*

The formation of amorphous silica in soils is the result of weathering and pedogenesis. Biogenic forms of amorphous silica – phytoliths – can be identifiers of individual plants and phytocenoses, and characterizers of evolution of local plant communities in the changing external conditions. The phytolith analysis is of great significance for paleosoil, paleobotanical, and archeological investigations, and supplements essentially palynological studies (Golyeva, 2008; Piperno, 1988). Phytoliths in the soils of Priamurye were not actually studied. This research is aimed at a qualitative and quantitative assessment of the content of major phytolith forms (morphotypes) in the meadow soils of the Mid-Amur Lowland as exemplified by the meadow podbel.

Phytoliths are diagnosed in all genetic horizons of the study meadow podbel, and also in the soil-forming sediment. The entire profile shows the dominance of the phytolith group of dicotyledonous grasses and graminifolious plants (meadow and forest), which reflects the greatest role of these plants in the modern vegetation cover of meadow podbels, and also as part of phytocenoses at the past stages of sedimentation and soil formation. Actually, the entire absence of phytoliths of the arid zone flora is evidence that by and large, sedimentation and soil formation within the bounds of the thick sequence of deposits penetrated by the studied soil profile proceeded when moisture content was maintained and meadow (meadow-boggy) and forest vegetation were developing.

The maximum of the content of phytolith bodies was recorded at a depth of 22–80 cm (the eluvial-gley ELnn,g and the illuvial B1Tg horizons). A much lesser content of phytoliths in the humus-accumulative horizon AUg testifies to the relative youth of the humus-accumulative horizon of the meadow podbel. The illuvial horizon B1Tg most likely formed in the process of synlithogenous soil formation, when regular supply of organic material (grass and leaf litter) onto the surface took place with its subsequent burial and conservation. The organic-accumulative origin of the horizon is supported by the cuticular casts detected there.

At a depth of about 220 cm the portion of phytoliths of forest cereals increases by several times against the portion of meadow cereals. Simultaneously, the quantity of phytoliths of pine-needles grows, and the percentage of phytoliths

of dicotyledonous grasses (miscellaneous herbs, legumes, etc.) drops substantially. Thus, it can be presumed that the accumulation of sediments, particularly at a depth of about 200 cm, occurred in conditions of extensive forest coverage of the territory and development of the forest phytocenosis dominated by coniferous woody species.

Thus phytoliths observed in the soil profile of the meadow podbel belong to the following plant groups: dicotyledonous grasses, forest and meadow cereals, coniferous (pine-needles), semi-bog (reed, rush), and unspecified plants of dry-steppe flora. The analysis of their content, species diversity and correlation of forms made it possible to assess the specific features of the present and the former phytocenoses.

**ANALYSIS OF SECRETOME AND IDENTIFICATION
OF USEFUL ENZYMES FROM *PSEUDOMONAS JAPONICA*
ISOLATED IN RUSSIA**

Shir-Ly HUANG¹, Marina L. SIDORENKO², Khanh Chi HOANG^{1,3},
Chih-Chen CHEN¹, Yi-Chin CHENG¹, Hsin CHEN⁴

¹*Institute of Microbiology and Immunology, National Yang-Ming University, Taiwan*

²*Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia*

³*Pharmacological, Medical and Agronomical Biotechnology,
University of Science and Technology of Hanoi, Vietnam*

⁴*Department of Life Sciences, National Central University, Taiwan*

The colder continental, polar and subarctic climates dominate in far east region of Russia has unique geological features. The unique geological features provide rich sources for the isolation, characterization of unique microbial species, particularly for the investigation of psychrophilic microorganisms. These microbial strains were shown to produce enzymes at lower temperature which can also be used commercially such as in various industries and in agriculture. The cold-active enzymes produced by psychrophilic microorganisms that can function in cold environment and have a more flexible structure to undergo the conformational changes necessary for catalysis with a lower energy demand. The marginal sea and soil samples were collected and 7 psychrophilic strains were isolated for the screening of potential cold-active enzymes using a high-throughput plate-based method. The screened enzymes include cellulase, xylanase, laccase, and protease. Macromolecules such as cellulose, hemicellulose, lignin, proteins, phytic acid, oils are present in the environment. With help of microbial secretory enzymes, macromolecules are biodegraded to smaller molecules, e.g. saccharides, amino acids, fatty acids, etc., to facilitate their uptake into cells. One of the psychrophilic strain, *Pseudomonas japonica* strain 13, was shown to produce multiple secretory active enzymes including cellulase, amylase, xylanase and pectinase at 10 and 20 °C. The bacterial strain was cultured in defined medium at optimal growth temperature and colder temperature (20 °C and 10 °C) to compare their secretomes by using subtractive proteomic approach. In addition, the sensitive mass spectrometric analysis of the protein in secretomes obtained at different temperatures will provide the identities of key proteins to further elucidate the physiology of psychrophilic bacteria response to temperature change in the environment.

THE POSSIBILITY OF USING HUMATES DIFFERENT ORIGIN AS A COMPONENT OF THE CULTURE MEDIUM FOR EXPERIMENTS

Darina I. KARPOVA, Olga V. NESTEROVA

Department of Soil Science, Far Eastern Federal University, Vladivostok, Russia

Humic acids of soils are a group of natural high-molecular substances, which are characterized by high physiological activity due to the peculiarities of the structure, physical and chemical properties. They are a source of structural fragments for organic macromolecules in biosynthesis in living organisms. And interact with organisms they stimulate growth and development. This is the main reasons why humates have their wide application in agriculture, veterinary and medicine.

Actively used in medicine, biological additives based on humates, and also humates allocated from the top of soils horizons can be an alternative, low-cost source of nutrients for cell cultures in biological experiments.

The purpose of this work is to identify the possibility of using humates recovered from various natural objects as a component of the culture medium for cells cultivation for biological experiments.

As material for a research were humic acids emitted from Chernozem, Cambisols and nutritional supplement gumivit-K. The possibility of cells cultivation with addition of humates as culture medium was tested on cultures of alveolar and peritoneal macrophages, selected by a standard method from the biological material of the male rat (Wistar line).

Cell cultures were grown under standard culture conditions on embryonic calfskin serum with addition of humates at concentrations of 0.001 % and 0.0001 %. The experiment lasted 28 days. Control of the macrophage culture was carried out on 3, 12, 15, 17, 19, 28 day by confocal microscopy using laser scanning microscope LSM 510 Meta Carl Zeiss.

Researching of macrophages at different concentration of humates in serum during the experiment has revealed positive effect of impact of humic medicines on the general condition of culture, protective and immunostimulating properties expressed on cells. However, the best response of cells was observed when using humates of a Cheronozem and Cambisols. At lower concentration (0,0001 %) they showed more effective result, than a pharmaceutical humate (humivit-K) in a concentration of 0,001 %

Based on this fact, it is possible to make a conclusion that humates perfectly are suitable for use as an alternative source of nutrients for cells cultivation.

SPECIFIC OF HUMUS COMPOSITION OF BUROZEM OF LAZOVSKY NATURE RESERVE (PRIMORYE TERRITORY, RUSSIA)

Irina V. KISELEVA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

In recent years, a conception of the leading role, among other factors, the impact of the ocean on the processes of soil formation in coastal areas was formed. It concerns of widespread in the south of the Far East, Burozems (Brown Forest Soils or Cambisols (classification of WRB)). The effect of the ocean on soil-forming processes can be most clearly traced in the example of soil cover of protected areas that are not subject to anthropogenic influence.

Field studies were performed in valley of river Perekatnay of Lazovskiy Nature Reserve. We studied 15 different variants of Burozems (Cambisols). The reserve is located in the coastal area of moderate climatic zone of the Far East. In this territory there are significant climatic contrasts. Their reason is the role of the ridge Zapovedniy as a barrier in the way of air masses.

The humus content was determined by Tyurin's method; the fractional and group composition of humus, by the method of Tyurin, modification Ponomareva and Plotnikova.

The main morphological features of soils are studied: low power soil profile (50–70 cm), the weak differentiation of genetic horizons, strong gravelly, high humus content of the soil profile.

Depending on the location of the soil in the relief it had significant differences in the humus composition. Soils formed on the lower elements of relief are characterized by low power litter (up to 2 cm) and high humus content of the surface horizon (9,4–12,4 %) at humate-fulvate humus in it (Cha/Cfk 0,80–0,94) and fulvate in the lower (0,35–0,38). In humus composition are dominated by brown humic acid, free and bound to Al and Fe oxides.

The humus content in the soils of the watershed surface is high (7,9–9,8 % in the surface horizon) Humification goes on fulvate-humate type (Cha/Cfa = 1,35–1,62). Early it was thought that this type of humification is not typical for Burozems (Cambisols). However, studies later period indicate that brown forest soils and other coastal soils of the island and continental coastal marine ecosystems humification can go and fulvate–humate type (Zonn, 1976 Ivlev, 1987; Makarevich, 1977; Pshenichnikov, Pshenichnikova, 1978).

The feature of brown forest soils (Burozems (Cambisols)) is also a presence in the composition of their humus of large proportion of humic acids bound with calcium (up to 45 % of the amount of humic acids). Recent studies (Pshenichnikov, Pshenichnikova, 2002) have shown that the active formation and accumulation of brown humic acids, humates and fulvates of calcium in humus is reflect facies

of humus formation in continental-coastal burozems. These soils are formed in conditions of sea hydrothermally-pulvirization regime. This regime causes impulverization brings of sea water, as well as their components (especially calcium, magnesium, sodium, sulfates) in composed of sediment, which determines originality of not only weathering and humus formation. Thus, the predominance in composition of humus of burozems of humic acids, as well as calcium humates is not an accident, and regularity, most clearly manifested in Burozems coastal strip.

HEAVY METALS CONTENT IN THE SOILS OF BROAD-LEAVES FORESTS OF PRIMORYE TERRITORY

Serafima V. KLYSHEVSKAYA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

The soils in broad-leaves forests of Primorye Territory were surveyed on heavy metal contamination. The total heavy metal contents can indicate the extent of contamination, but is not usually an accurate indication of the phytotoxicity; therefore many recent studies investigated the bioavailable heavy metal fractions of soils.

Soil samples were collected in three forest formations: cedar-broad-leaved forests (predominantly Korean pine), pine–oak forests (predominantly Mongolian oak) and in the valley coniferous–broadleaved forests formed mainly by Valley Elm, Japan Poplar, Mandshurian Ash, maples, Khingan Fir and Ajan Spruce. These spots belong administratively to the Mikhailovsky, Nadezhdensky, Pogranichny, Khasansky, and Shkotovsky districts, to Popov and Russky islands and to the Ussuriisky Nature Reserve of the Primorye Territory. One hundred and fifty samples were taken out from rhizosphere of 15 woody species.

The evaluation of total content and bioavailable fractions of Fe, Mn, Zn, Cu, Co, Ni, Cd, and Pb was performed in soil samples by atomic–absorption spectrophotometer Hitachi–05 M and plasma–emission spectrophotometer “Shimadzu” AA-6601F in the Analytical Center of FEGI FEB RAS.

Total heavy metal contents in soils of the area under study do not exceed the maximum permissible concentration (MPC). The overall level of contamination with bioavailable forms of heavy metals can be characterized as satisfactory, that confirms our previous studies. A simultaneous exceeding of permissible contents of lead, copper, cadmium, and zinc was observed in investigated soils except of soils in reserves and on insular areas.

Thus, soil samples selected on the territory of the Ussuriisky Reserve and the islands of the Peter the Great Bay can be used as «reference» samples when the area subjected to anthropogenic pollution is studied.

INFLUENCE OF BIOCHAR ON POPULATION OF SOIL

Yulia A. KOLESNIKOVA¹, Viktoriia A. SEMAL^{1,2}

¹ *Department of Soil Science, Far Eastern Federal University, Vladivostok, Russia*

² *Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia*

The necessity to study effect of biochar on living organisms of the soil, the overwhelming part of which is made up of microscopic organisms, is due to their important role in the formation and regulation of the atmospheric gas composition. As a result of their vital activity, microorganisms return to the atmosphere carbon dioxide, H₂, H₂S, N₂O, CH₄. In this regard, many natural scientists are interested in the idea of controlling the microbial processes of the soil. Is it possible to direct the work of soil organisms to the side necessary for mankind with the help of biochar?

In the present work, those properties of biochar that directly affect microbial communities will be identified. This will create a theoretical basis for modeling the melioration process in the future and develop a program for the application of biochar for soils in the Primorye Territory.

The purpose of this work is to reflect the influence of biochar on microbiological communities of soils according to literature data.

Biochar is a product obtained from biomass of various origins (waste wood, manure, straw, bones and other organic material) when heated without oxygen. It's a good adsorbent, has a complex porous structure that is able to absorb moisture and many nutrients needed by microorganisms and plants, and also serves as a safe haven for microscopic organisms.

In this paper, the biochar properties have been determined that positively influence the number and biodiversity of microorganisms in the soil: low pH, large specific surface area, optimal pore size (2–4 nm), high nutrient content (P, K, N) and C, high water capacity. This biochar promotes alkalizing the soil, gives it the ability to sorb more microorganisms, their enzymes, as well as harmful toxins and TM, increases the supply of moisture and nutrients in the soil.

In addition, it was clarified how the microbiological processes of nutrient transformation changed when biochar was applied to the soil. Namely: the rate of decomposition of organic substances increases and the emission of greenhouse gases decreases due to a decrease in the intensity of the processes of denitrification and greater availability of N for microorganisms and plants.

Finally, prospects for the use of biochar in the Primorye Territory were shown. The soil fertility of the Primorye Territory can be significantly increased due to an increase in the rate of decomposition of organic substances with the introduction of this ameliorant. Biochar will also help to reduce the level of greenhouse gas emissions in soils used for rice cultivation.

SOILS OF THE FAR EAST IN THE NEW RUSSIAN SOIL CLASSIFICATION SYSTEM ON THE UPDATED VERSION OF THE SOIL MAP OF RUSSIA (1 : 2.5 M SCALE)

Dmitry E. KONYUSHKOV¹, Maria I. GERASIMOVA^{1,2}, Tatiana V. ANANKO¹

¹ *Dokuchaev Soil Science Institute, Moscow, Russia*

² *Lomonosov Moscow State University, Moscow, Russia*

V.V. Dokuchaev Soil Science Institute has initiated a project on updating the Soil Map of Russia (1988, 1 : 2.5 M scale) with the aim to reflect the current state of the soil cover, including both natural and human-transformed and degraded soils. The new map will be developed with the use of modern methods of digital soil mapping and the new substantive-genetic classification system of Russian soils (2004, 2008).

At the first stage, mapping units shown on the original map are reclassified into the new system. This is done separately for each soil polygon with due account for the local conditions. Corresponding information is added to the database of the digitized version of the original map. Additional information is provided for agricultural soils. The polygons and their boundaries remain intact; they will be modified at the second stage.

Our experience has shown that an “automated” translation of legend units into the new classification system is inadequate. Soils of each polygon, or group of polygons within a given region have to be renamed individually. Along with the creation of the updated version of the map based on the new Russian soil classification system, this work is also aimed at careful examination and refinement of this system. It might be helpful in further representation of the map with the use of international classification decisions (e.g., the WRB system).

In the course of reclassification, all available cartographic materials and published works are analyzed. However, more active participation of local experts in this work is desirable and highly welcomed.

The diversity of environmental conditions in the south of the Far East is great: from mountainous tundra and taiga landscapes to mixed broadleaved–coniferous and broadleaved forests of the foothills and mesophilic and steppe meadows on the plains. The diversity of soils is also considerable: the legend of original map includes 31 soils for this region. For most of them, their direct analogues in the new Russian soil classification system can be found. For some soils, their reclassification in particular polygons requires differential solutions. Thus, the polygons with meadow differentiated soils on the original map have been reclassified into several groups: dark-humus gleyic podbels, dark-humus gley podbels, mucky-humus podzolized dark-tonguing gley soils, and dark-humus gley and quasigley soils (including podzolized and solodic variants). The reclassification of soddy

pale–podzolic soils and podzolic–burozemic soils and their deeply gleyic and gleyic variants proved to be debatable. As a preliminary decision, these soils have been reclassified as dark–humus podbels with further differentiation at the subtype level via adding gleyic, gley, and raw-humus qualifiers. A debatable problem is the boundary between rzhavozems and burozems as must be shown on the new map. Are there rzhavozems under mixed broadleaved–coniferous forests? What kind of parent materials and what topographic conditions are characteristic of rzhavozems (brown taiga soils, or raw–humus burozems)? Other problems of soil geography of the Far East as shown on the new map are to be discussed. In the report, the new version of the map for the Far East will be presented, and debatable problems of reclassification of local soils in the new Russian system will be outlined. We invite all interested persons and experts in soils of the Far East to participate in further discussion.

SEASONAL DYNAMICS OF GREENHOUSE GAS FLUXES BY SOILS OF RUSSKY ISLAND

Sergey KOROVIISKII¹, Luca Belelli MARCHESINI^{1,2,3}, Valentina TREGUBOVA¹

¹ *Department of Soil Science, Far Eastern Federal University, Vladivostok, Russia*

² *VU University, Amsterdam, The Netherlands*

³ *Euro-Mediterranean Centre for Climate Change, Lecce, Italy*

Today, the seasonal dynamics of greenhouse gas fluxes by natural and anthropogenic soils of the island territories remains poorly understood.

The data obtained in the study showed the presence of pronounced seasonal dynamics of CO₂ and CH₄ flows by soils of the island territories on the example of Russky Island, depending on such abiotic factors as temperature and humidity.

The seasonal dynamics of the soil greenhouse gas fluxes of island territories correlates most strongly with this parameter, as is soil temperature.

The aim of this study is to determine the seasonal variability of carbon dioxide and methane fluxes in the soils of Russky Island, depending on temperature and humidity.

Objective of the study:

1. Study of physical and chemical properties of soils in key areas of the island.
2. Measuring fluxes of CO₂ and CH₄ in the soils of the University campus.
3. Measurement of abiotic soil and air parameters such as temperature and humidity.

The object of study includes 5 key areas located in different ecosystems on different elements of the landscape, reflecting the features of the Russky Island.

The analysis of soil flows of CO₂ and CH₄ revealed the main regularities of spatial differentiation of seasonal dynamics of flows. The main abiotic factor determining the resultant emission of soil fluxes of carbon dioxide and methane under the conditions typical for the background ecosystems of Russky island is the temperature of the soil cover ($R = 0.51-0.81$).

Soils in the meadow showed the highest rates of CO₂ emissions with maximum values of up to 1100–1200 mg/m² h. As for methane, small emissions were observed on the shore of an artificial pond during heavy rains.

POTENTIALLY TOXIC ELEMENTS (SR, V) CONTENTS IN UNDISTURBED NATURAL SOILS: SHELIKHOV BAY COAST, RUSSIAN FAR EAST

Yulia A. KOSHELEVA, Yana O. TIMOFEEVA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Despite extensive studies, little is known about the natural Sr and V contents and the relationship between contents of these elements and soil properties in the natural environment. Numerous studies have been shown that these elements are potentially dangerous for the natural environment. The hazard class of Sr and V varies from low hazardous (in Russia) to most hazardous (UNEP), according to the toxicological classification of elements of different countries and organizations [3]. Soils in different parts of the world, particularly in urban and industrial regions, contain high contents of these elements. Strontium and V may enter the air, water, and soil from different anthropogenic sources [1,2].

Most studies of these elements in soils from the Pacific region have been performed on soils from urban and agricultural areas, and such data cannot provide comprehensive information about the natural background contents of Sr and V and whether anthropogenic activities have altered element contents in soils. Soils of the Shelikhov Bay coast have formed in uncontaminated fields are ideal material for investigating the natural baseline Sr and V contents and migratory cycles of elements in the pedosphere under natural conditions.

The objectives of this study are as follows: (i) to quantify the natural baseline total Sr and V contents in soils of the Shelikhov Bay coast; (ii) to identify the main factors controlling the vertical distribution and accumulation of elements in soil profiles; (iii) to evaluate the anthropogenic influence on the soils in the territory of the Shelikhov Bay coast.

In this work, we collected 24 soil samples from conditionally pollution-free soils from Shelikhov Bay coast. The soils used in this study are classified as Rustic Podzols, Sapric Histosols, Sideralic Arenosols, and Entic Podzols according to the World Reference Base for Soil Resources [4].

The levels of trace element contents in the soils from Shelikhov Bay coast depend on the mixed influence of natural environmental conditions and additional inputs of elements originating from atmospheric deposition of long-distance transported pollutants. The total contents variations of elements in the studied soils were (mg kg⁻¹): Sr (78.07–312.95) and V (26.30–84.25). Minimal all studied elements concentrations were observed in the Sapric Histosols. The maximum contents for Sr and V occurred in the Entic Podzols. Studied elements had tended to accumulate in the middle and lower parts of the soil profiles. Technogenic forms of Sr and V were observed in the studied soils which were formed on the

territory without technogenic impact. The technogenic index of these elements varied from 14 % to 42 % for V and from 11 % to 32 % for Sr, and indicated inputs of elements from external sources. The main phases controlling the distribution and accumulation of Sr and V in the soil profile are Si- and Al-phases by low values of technogenic index. The technogenic index increase is accompanied by an increase of the relationship of V with Fe-phases.

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THE INFLUENCE OF FIRES ON THE PROPERTIES OF BUROZEMS OF RUSSKY ISLAND

Larisa A. LATYSHEVA

Pacific Institute of Bioorganic Chemistry FEB RAS, Vladivostok, Russia

Presently, the investigation of postpyrogenic changes of the soil and plant covers is considered important in solving genetic and evolutionary problems. Island ecosystems of the Far East are in the zone characterized by optimality conditions for the emergence and spread of fires. Forest fires have a considerable influence on transformation of soil organic matter, its qualitative composition of humus, physicochemical properties. To identify the influence of the pyrogenic factor on the soil properties, we studied burrozems under light oak forests with a well-developed grass-shrub layer and burrozems under wormwood communities within Russky Island. Burrozems developed under antropogenic successions of oak forests are characterized by the O–AU–AUBM_{hi}–BM_{hi}–BC. The differentiation of the profile of this burrozems is due to the humus-accumulative and humus-illuvial processes. It manifested itself in the presence of organomineral coatings on peds faces in the AUBM_{hi} and BM_{hi} horizons and tongue-shaped pockets of humus in the upper part of the BM_{hi} horizon.

In the Western part of the Island under the thickets of wormhole associations forming burrozems characterized by the O_{pir}–AU_{pir}–BM_{hipir}–BM–BMC profile with distinct features of the pyrogenesis in the humus-accumulative and humus-illuvial horizons. A comparative analysis of physicochemical characteristics of the studied burrozems shows the deterioration of forest-growing properties under the influence of fire. The humus content decreases almost twofold (from 14.92 % to 7.60 %) in comparison with those not affected by fire. There is a tendency to decrease total acidity down the profile on the background increase in the content of exchangeable cations. This fact is explained by the removal of soluble ash components by rain and thawed waters. A characteristic feature of the group composition of humus in burrozems studied is the preservation of the fulvate–humate composition of humus both in humus–accumulative and humus–illuvial horizons. Although, in pyrogenic burrozems ratio between the contents of humic and fulvic acids decreases in humus–accumulative horizon (1.06) and increases in humus-illuvial horizon (1.21) in comparison with burrozems under oak-lime forest (1.15 and 1.09 respectively). Also, the content of humic acids and their fractional composition differ in the studied soils. The pyrogenetic burrozems are characterized by increased levels of brown and black humus acids in humus–illuvial horizon (BM_{hipir}) in comparative with burrozems under antropogenic successions of oak forests. The distribution of the second and first fraction of humic acids has an illuvial pattern with a maximum in the illuvial horizons as in profile of pyrogenic burrozems, so and

in profile of burozems not affected by fire. In the burozems under antropogenic successions of oak forests the relatively content of brown acids in the lower part of the BM_{hi} horizon exceeds that in the pyrogenic burozems. Which may be related with increasing of soil acidity of the burozems under light oak forests with depth to pH_{H_2O} 5.5 against 6.2 in burozems under the thickets of wormhole associations. With an increase in the soil acidity, the mobility of first fraction of humic also increase.

Our research data illustrate specificity of physicochemical properties, qualitative composition of the island burozems humus, resulting from fires influence on the soil and vegetation cover of the island.

PROTEOMIC ANALYSIS OF THE SECRETED PROTEINS FROM THERMOACIDOPHILIC ARCHAEON *SULFOLOBUS ACIDOCALDARIUS*

Ting-Ting LIU¹, Hsin CHEN¹, Chen-Tsung WENG², Shir-Ly HUANG²

¹ Department of Life Sciences, National Central University, Taiwan

² Institute of Microbiology and Immunology, National Yang-Ming University, Taiwan

The acidic hot spring provides a cradle to enrich the thermoacidophilic microorganisms. These organisms are shown to have stable and active enzymes to survive in an acidic and hot condition. They act as a source to identify the heat- and acid-stable enzymes for the application in biotechnology and various industries.

Sulfolobus is a well-characterized thermoacidophilic genus. *Sulfolobus acidocaldarius* is focused in industrial applications due to having less mobile elements which is important for genetic engineering. *S. acidocaldarius* DSM639, the type strain of *Sulfolobus* genus, was isolated from acidic hot spring in Yellowstone National Park, USA. It can grow in acidic hot spring at 55–85 °C and pH 2–3 and, therefore, be used to investigate novel extra-cellular proteins in hostile environments. Via proteomic approach, a total of 184 proteins were identified in the secretome of this strain. They are 123 proteins by the gel-based method and 23 proteins by the gel-free method. The majority of the identified extracellular proteins of *S. acidocaldarius* DSM 639 were classified as hypothetical proteins (72 unique proteins, 39%), followed by the extracellular enzymes (35 unique proteins, 19%), protein related to ATP binding and transport (25 unique proteins, 14%). Particularly, there are 84 unique proteins (49%) previously not annotated to *S. acidocaldarius*. These special proteins are identified to 44 archaea respectively. By analyzing the phylogenetic tree with the 44 archaeal species with *S. acidocaldarius*, there are 24 species (9 hyperthermophiles, 3 thermophiles and 12 mesophiles) belong to Euryarchaeota and 15 species (11 hyperthermophiles and 4 thermophiles) belong to Crenarchaeota, the two major archaeal phyla. Three species (thermophiles) are from the uncultured archaeal phylum Korarchaeota and one species (psychrophiles) is belong to the newly established phylum Thauarchaeota.

These results suggest many interesting and unique secreted proteins from the microorganisms grown under extreme environment for further basic/physiological and application studies.

GEOCHEMICAL COMPOSITION OF THE MORTMASS AS A CRITERION FOR MONITORING THE STATUS OF BIOCENOSES ON THE RUSSKY ISLAND

Raisa A. MAKAREVICH, Larisa A. LATYSHEVA

Pacific Geographical Institute, FEB RAS, Vladivostok, Russia

The mortmass is the most informative object for estimating the integrated pollution of the natural environment. Localizing on the soil surface, it serves as a primary depositor of the atmospheric depositions both directly on its surface and absorbed by the vegetation and included in it as a result of the annual dying-off of living matter. In the absence of the atmospheric and anthropogenic pollution, the mortmass includes only elements from the biogenic accumulation cycle. Therefore, it was the mortmass that was chosen as the object for control over the changes in accumulation of heavy metals in biocenoses on the Russky Island.

The Russky Island is a part of Vladivostok city which is of more and more significant geopolitical and economical importance in the Asian-Pacific region. This is a motivating factor for activating the processes of the city development and expansion. For this reason, the substantial integration of the earlier undeveloped grounds of the Island into the urbanization and settlement area began from 2009. The development of the city infrastructure is inevitably accompanied by both transformation of natural complex and delivery to the outside environment of different pollutant substances. Under conditions of the urban territories, the heavy metals come to the fore from the spectrum of pollutant substances. Their major sources include the technological and economic-communal activities. Due to the high toxicity of heavy metals for all flesh, including a human, the control over the dynamics of their concentrations in the objects of the urban environment and components of natural biocenoses is necessary. The reliable estimate of the dynamics is possible on the basis of information on contents of these metals in the natural objects prior to the urbanization of the Island territory. Such studies were carried out in 2002.

The concentrations of lead, zinc, cadmium, copper, cobalt, nickel, manganese and iron were determined in the absolutely dry substance and ash of the mortmass within some elementary geochemical landscapes of the Island. The obtained results show that the mortmass differs markedly in ash-content and content of metals in the absolutely dry matter. At the same time, the concentrations of each metal in the mortmass ash from different biocenoses proved to be close against each other. Therefore, when monitoring the heavy metal pollution of the Russky Island environment, this more stable characteristic should be used. Just it reflects the regional specificity of the biogenic accumulation of elements caused by the climatic and geological peculiarities of the territory. At that, the differences in

the structure of the vegetative associations of elementary landscapes within the boundaries of the deciduous forest prove to be practically insignificant.

As a result of the study performed, the background concentrations of lead, zinc, cadmium, copper, cobalt, nickel, manganese and iron were determined in the mortmass of the Russky Island prior to active urbanization of its territory. The obtained quantitative estimates of the metal accumulation in the mortmass ash should be considered as their natural geochemical background and used for control and estimating the pollution of the Island environment.

DIVERSITY OF SOIL OF THE JEWISH AUTONOMOUS REGION AND THE USE IN AGRICULTURE (RUSSIAN FAR EAST)

Lira A. MATIUSHKINA¹, Vera B. KALMANOVA²

¹ *Institute of Water and Ecology Problems, FEB RAS, Khabarovsk, Russia*

² *Institute for Complex Analysis of Regional Problems, FEB RAS, Birobidzhan, Russia*

The paper describes the soil cover diversity in the Jewish Autonomous Region (JAR), located in the “center” of the southern part of the Russian Far East. The soil diversity in this region is determined by the combination of mountain and lowland terrains, different climatic conditions, a complicated water regime, and vegetation cover specifics. All of these factors noticeably change from south to north and from west to east. Diversity of JAR soils reflected on the map of the basic types (groups) of soils in the scale 1:1 500 000.

In the mountains in accordance with the vertical landscape zones there are brown mountain-forest soils (brownzems). They are divided into weakly-unsaturated under the oak and broadleaf forests, raw humic under the light larch forests, acid under the coniferous forests, illuvial-humic under the grass-moos moor larch forests with spruce and abies. In conditions of poor drainage or additional surface moisture brownzems gleyic and/or gley are formed. Brown mountain-forest soils weakly-unsaturated are most common. The structure of the morphological profile is AY-BM-C. Podburs dry-peaty have a special place in mountainous soil group. They are formed in the far north of JAR in the Bureisky Ridge in the upper part of the larch forests belt and in cedar elfin wood belt. The structure of podburs profile is TJ-Bhf-C.

In the transition zone from mountains to lowlands forest podbels are widely spread in the broadleaf-oak forests. In the regional classification they are called brown bleached soils. Now they are diagnosed by the presence of the texture-differentiated profile AY-ELnn-BEL-BT-C. The forest podbel specific feature is that under the humus horizon there is a greyish-whitish (bleached) horizon with numerous Fe-Mn concretions.

Soils with increased and excessive moisture are common in the lowlands. These include meadow soils with a bleached horizon (meadow podbels) under the motley-grass-sedge-small reed vegetation with the profile structure AU-AUel,nn,g-ELnn,g-BELTg-BTg-C and meadow gley soils (AU-G-CG) under sedge-vejnik meadow vegetation. In the lowland marshy meadows peaty-gley and peat-gley soils are widely spread, and under the larch mari upland peat-bog soils are common. The profile structure is T-G-CG, where the horizon T is 20–30 cm thick in peaty-gley soils and 30–50 cm thick in peat-gley soils.

In the floodplain of the Amur River and other major rivers alluvial soils vary, including primitive layered, well-developed sod, meadow and brown forest soils

developed on alluvial sediments. Sod and brown forest alluvial soils (on the sand bars) with a well-developed humus horizon (up to 12 cm) are considered the best for farming. However, they occupy a small area in the overall structure of the JAR land fund. At the same time, the widespread meadow gley soils, meadow and partly forest podbels have a high potential fertility, however they require reclamation. Amelioration of these soils through drainage-collecting systems will greatly improve their water–air regime and the vegetation conditions for various crops. The agricultural efficiency of reclaimed also depends on the systematic cultivation of soils (increasing the plough layer thickness, the application of lime, mineral and organic fertilizers).

Prospects for rational use of soils in JAR much depend on taking into account landscape-ecological conditions of the soil formation, the application of new technologies of reclamation and agriculture.

PARASITIC NEMATODE SPECIES DIVERSITY IN BUROZEMS OF CONTINENTAL ISLANDS OF PETER THE GREAT GULF (SEA OF JAPAN)

Tamara I. MUKHINA¹, Boris F. PSHENICHNIKOV¹, Nina F. PSHENICHNIKOVA²

¹ School of Natural Sciences, Far Eastern Federal University, Russia,

² Laboratory of Biogeography and Ecology, Pacific Geographical Institute FEB RAS, Vladivostok, Russia

Parasitic nematode species of the Peter the Great Gulf islands are not very well studied. We tried to cover some blank spots by studying diversity and dynamics of the species found in burozems of Bolshoi Pelis Island. The island is located 60 km southward of Vladivostok. It is characterized by low mountainous relief and diverse vegetation. The northern half of the island is covered by middle-aged grass-shrub oak forests. The southern one is dominated by Gmelin wormwood associations, which are the result of anthropogenic transformation of oak forests. Two evolutionally connected subtypes of burozems make most of the island soil cover. Typical burozems are spread under grass oak forests. The profile of these burozems is differentiated into the following horizons: O–AY–BM–BMCU. Burozems with a highly humified profile are spread under grass and grass-shrub associations of Gmelin wormwood. The profile of these burozems has horizons O–AU–BMhi–BMC. We named this subtype of burozems dark humus-illuvial burozems. A comparative study of our research data shows a number of trends in qualitative and quantitative dynamics of parasitic nematode species found in burozems of the island. The species dynamics depends greatly upon specific soil ecology conditions, existing in the burozem types. Typical burozems undergo gradual extension of their projective grass cover (from 15 to 25 %) as well as consequent increase of humus horizon depth (from 7 to 10 cm). Due to these changes the number of parasitic nematode species increases from 6 to 11 in this type of burozems. Dark humus-illuvial burozems undergo massive extension of their projective grass cover (up to 98 %) and increase of humus-accumulative horizon depth (up to 22 cm). These changes cause a sharp increase in the number of parasitic nematode species in this subtype of burozems – 23 species. We found the total of 32 parasitic nematode species in both burozem types. 31 of them belong to *Tylenchida* order, and one species – *Xiphinema americanum* – is that of longistyletes nematodes of *Dorylaimida* order. Parasitic nematodes of this species inhabit tree roots and bush roots mostly. The species is considered to be a carrier of dangerous virus diseases. Large number of the nematodes was found in dark humus-illuvial burozems. Dangerous root parasites of *Heterodera* species and *Helicotylenchus* species were found in both burozem subtypes. But dark humus-illuvial burozems have a much larger number of these parasites than typical burozems. Many saprobiotic nematodes that we

found are micohelminthes: *Aphelenchus sp.*, *Aphelenchoides sp.*, *A. bicaudatus*, *A. parasubtenuis*, *Seinura sp.*, *Sakia sp.*, and phytohelminthes of non-specific pathogenic effect: *Boleodorus sp.*, *B. rapsus*, *Ditylenchus intermedius*, *D. microdens*, *Nothotylenchus sp.*, *N. antricolus*, *N. Buckleyi*. Specific root parasites are also quite diverse: *Criconema sp.*, *Xenocriconemella sp.* (only in typical burozems), *Radopholus pumilis*, *Rotylenchus sp.*, *Tylenchorhynchus sp.* The most numerous species are *Boleodorus*, *Tylenchorhynchus sp.*, *Paratylenchus sp.*, *Rotylenchus sp.*, found only in dark humus-illuvial burozems. The specificity of parasitic nematode species distribution is due to the degree of comfort that soil ecology conditions offer for live and reproduction of the species.

BIODIVERSITY MARINE FUNGI FROM SUBAQUEOUS SOILS OF THE SAKHALIN ISLAND AREA

Mikhail V. PIVKIN

G.B. Elyakov Pacific Institute of Bioorganic Chemistry, FEB RAS, Vladivostok, Russia

During investigation of the mycobiota in the Sea of Okhotsk, three new *Penicillium* species were isolated from subaqueous soils collected in the Sakhalin Gulf and in the northeastern part of the Sakhalin shelf, near the Piltun Bay. According to Raper and Thorn's classification, the newly described species *P. piltunense*, *P. ochotense*, and *P. attenuatum* belong to subsection Divaricata. Two analyses were performed to reveal the phylogenetic relationships of the putative new species with other *Penicillium* species. Phylogenetically, the new species are related to the members of the *P. canescens* group and share some morphological and physiological features with them. However, they differ in having a larger colony diameter that makes them similar to *P. atrovenetum*, *P. coralligerum*, and *P. antarcticum*. A detailed analysis based on ITS, combined β -tubulin and calmodulin datasets, and morphological features revealed that the new species formed a distinct group inside the *P. atrovenetum* subclade. Moreover, *P. attenuatum* differs from the other two species macro- and micromorphologically and may represent a distinct phylogenetic lineage. Twelve new polyketides, zosteropenillines A–L (1–12) and eleven new polyketides, pallidopenillines 1–11 were isolated from the ethylacetate extract of Monovtrticillata section *Penicillium thomii* series fungi.

PROPERTIES OF SOILS OF ISLANDS OF THE GREATER KURIL RIDGE

Oleg V. POLOKHIN

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

The main distribution patterns of soil and vegetation of northeastern part of the Simushir Island, of central parts of the Urup and Iturup Islands were studied. The structure of the profiles and the morphological features of soils are shown. Vegetation description was given.

On the of Simushir Island pedogenesis has sinlithogeny (volcanic) character. The presence of ocherous horizon (BAN) with specific properties, evidence of large caldera-forming eruptions after which there was a long period of active soil formation. The appearance of pseudotyxtropy in ocherous volcanic soils was noted.

The absence of clearly diagnosed overlying ash-containing horizons indicating a weak lithogenesis at a later time. Under the Erman's birch forests there is an intensive accumulation of humus at a lower pH than in soils under the herbs-meadow vegetation. Other things being equal, the slope of the slopes, the orientation and the protection of the slopes with respect to the prevailing winds influence the development of the plant-soil complex.

On the Urup Island registration sites – on a sea terrace with coastal vegetation and on the steeply sloping surface of the Rudakov Mountain under arboreal and shrubby-meadow vegetation were laid. On the sea terrace, there are sod-layered sandy soils, and on the slope there are soddy–humic medium-thick volcanic soils. The absence of visible ash-containing horizons, the presence of buried horizons testifies to the long-standing large eruptions of the volcano Rudakov and the study area has been in the zone of weak ash falls for a long time. The morphological structure of the soil profile of sod–humus volcanic soils confirms that soil formation has a synlithogenic (volcanogenic) character. According to the values of the actual acidity, they can be attributed to soils with acidic (medium-acid) reaction of the medium. The acid-base properties of soils on the slopes depend to a large extent on the biogenic and climatogenic factors. In terms of the actual acidity, these soil soils are acid-nondifferentiated. Sod-layered sandy soils have higher $\text{pH}_{\text{H}_2\text{O}}$ values than sod–humus soils and correspond to soils with medium reaction from weakly acidic to near neutral. It can be assumed that the actual acidity of the soils of the sea terrace depends on the distance from the waters of the Sea of Okhotsk.

On the Iturup Island four user platforms were laid – two on the terrace with sea herbs–meadow vegetation and two on the Coast of Konservnaya bay of Chirip Peninsula under Erman's birch-oak forest with *Sasa kurilensis*. On the sea terrace developed sod-meadow soils, and on the coastal slope – burozems raw-organic humus ocherous. feature exposed soil profiles is the lack of clear-cut ash-containing

horizons. Each biocoenosis has a specific association type soils was found. Under the Erman's birch–oak forest with *Sasa kurilensis* is an intensive accumulation of humus at a lower pH than in soils under herbs–meadow vegetation.

BIOCHAR: SOURCES, PROPERTIES, AND APPLICATIONS

Anastasiya D. POPOVA¹, Viktoriia A. SEMAL^{1,2}

¹ *Department of Soil Science, Far Eastern Federal University, Vladivostok, Russia*

² *Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia*

The depletion of traditional energy sources, the increase in demand and prices for hydrocarbon energy resources are of concern to the entire world community. In order to ensure global energy and environmental safety, the world community is actively trying to reduce the dependence of energy on fossil fuels. One of the areas of development of modern energy is the use of biological resources.

The recorded climate changes for many regions of the Earth, as well as intensifying anthropogenic influences on the biosphere, in this connection – the world community proposes to transfer renewable biomass, which for various reasons cannot be directly used in the national economy, in biochar for conservation and reducing carbon emissions in soils. Also, an increase in the fertility of few humus soils is an urgent problem for Russia, and one of the ways to solve this problem is to introduce biochar into the soil.

A surge of interest in the use of biochar as a soil improver has caused the study of artificial soils of Brazil – ‘Terra Preta’ – with very high fertility, as well as the search for ways of long-term CO₂ removal from the atmosphere.

Biochar is a condensed coke residue with a sufficiently high content of carbon, which is formed as a result of thermal decomposition of biomass in the absence of an oxidizing medium in the temperature range from 450 °C to 900 °C. The composition of the initial biomass, the temperature and the rate of pyrolysis are the determining factors affecting the properties of the product obtained.

Biochar is intended for use in agriculture in order to increase the lungs’ fertility by the granulometric composition, depleted soils containing a small amount of humus and a decrease in the concentration of greenhouse gases.

MORPHO-CHEMICAL DIVERSITY AND TAXONOMY OF BUROZEMS IN PETER THE GREAT GULF ISLANDS (PRIMORYE TERRITORY, RUSSIA)

Boris F. PSHENICHNIKOV¹, Nina F. PSHENICHNIKOVA²

¹ *School of Natural Sciences, Far Eastern Federal University, Russia*

² *Laboratory of Biogeography and Ecology, Pacific Geographical Institute, FEB RAS,
Vladivostok, Russia*

Anthropogenic transformation of coniferous-broadleaved forests is the determining factor of burozem formation in the maritime–insular zone of the Japanese Sea. The transformation intensifies geochemical effect of the Pacific Ocean on the burozems, thus altering burozem alkali–acid ratio and sharply increasing magnesium ions in exchangeable cations. Consequently, humus mobility grows throughout burozem profile, humus accumulation intensifies, and elementary pedogenic processes (EPP) of humus eluviation and humus illuviation begin. Different EPP combinations causes morphogenetic diversity of the maritime burozems and provides a basis for a detailed burozem classification at type and subtype levels.

In burozems we distinguish subtypes of typical burozems and cinnamon-brown humus-illuvial burozems, and in dark burozems we recognize subtypes of dark typical burozems and dark humus-illuvial burozems. Typical burozems develop under broadleaved and coniferous-broadleaved forests. Profile O–AY–BM–C results from combined humus accumulation and claying EPP. The humus has humate-fulvate composition (Ch/Cf – 0.7–0.8), and profile distribution of the humus has accumulative character. Cinnamon-brown humus-illuvial burozems develop under thin oak forests. Just as typical burozems, the burozems in question have humate-fulvate composition of humus (Ch/Cf – 0.7–0.8), but the humus has far greater mobility in the upper part of a profile, with active illuviation of fulvic acids, especially their aggressive fraction, into the middle of a profile. The resultant EPP imposition – humus eluviation imposes on humus accumulation, and humus illuviation overlaps claying – forms the peculiar profile of the burozems (O–AY–BM_{f,hi}–C). Dark typical burozems develop under very thin grass–shrub oak forests. Profile O–AU–BM–C has a characteristic combination of dark humus and structural-metamorphic horizons. The burozem morphogenetic features are greatly predetermined by fulvate-humate composition of humus (Ch/Cf – 1.1–1.2) and by accumulative character of the humus profile distribution. Dark humus-illuvial burozems develop under steppe grass–shrub thickets. The burozems are characterized by greater humus mobility and by high levels of humic acids (Ch/Cf – 1.2–1.7). Consequently, profile O–AU–BM_{hi}–C has a strong (up to 40–50 cm) structural-metamorphic-humus-illuvial horizon, dark-grey or grey. The horizon is rich in humus (4–8 %), with high levels of black humic acid fractions and their derivatives with fulvic acids.

Furthermore, we have determined that in the southern Far East of Russia burozem types should include not only burozems and dark burozems but also polygenetic burozems with a simple profile and a complex profile. Polygenetic burozems with a simple profile combine lithogenic (inherited from relic residue) and modern (pedogenic) characteristics, and polygenetic burozems with a complex profile have buried humus horizons (evidence of proceeding pedogenic stages) (Tursina, 2012).

We have received data on profile dynamics of spore–pollen spectrum composition and reconstructed paleovegetation and climatic conditions which existed when each genetic horizon of the burozems developed. The data prove our assumptions regarding the nature of peculiar morphological structure, properties, genesis, and taxonomy of the burozems under study.

TO AN ESTIMATION OF THE HUMUS STATUS IN THE SOILS OF NATURAL AND AGROGENIC LANDSCAPES IN SOUTHERN REGIONS OF THE RUSSIAN FAR EAST

Lyudmila N. PURTOVA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Humification processes in southern regions of the Russian Far East most intensively proceed during the warm summer–fall period with the high biochemical activity of soils and the accelerated decomposition of plant residues. As a result, a shallow humus-accumulative horizon is formed with the predominance of humic acids (HAs) over fulvic acids (FAs) in soil humus. The involvement of soils in the land use system results in the enhancement of organic matter mineralization, the decrease in the content of humus. The aim of this work was to estimate the humus status in soils of natural and agrogenic landscapes in southern regions of the Far East in soils of different genesis. The objects of study included automorphic, semihydromorphic, and hydromorphic soils from southern regions of the Far East and waterlogged soils. Different physico-chemical method of study soils were used in the work. A high content of humus is typical for automorphic soils developed under broad-leaved oak forests and soddy–eluvial–metamorphic soils. According to pH_{water} values, humus formation occurs under weakly acidic conditions. From the humus status parameters, burozems and soddy-eluvial-metamorphic soils are characterized by a low content of free HAs and a high content of HAs strongly bound to the mineral soil basis. The share of calcium-bound HAs reaches a medium level. The content of humus in agro-dark-humus gleyic podbels is low. Humification processes occur under weakly acidic conditions (pH_{water} is 5.6). Ca^{2+} –bound HAs form a high proportion of HAs (53 %), which is typical for this soil type. The degree of humification is medium. The humus type changes to the humate–fulvate type.

In deep dark–humus gley soils, humification processes occur under weakly acidic conditions. The soils are characterized by a high content of humus (8.8 %) and medium reserve (123 t/ha) and degree of organic matter humification (24.6 %). Humus is of the fulvate–humate type. The free HA fractions dominate in humus; in the AU horizon, their content is medium (41.4 %), and the content of HAs strongly bound to the mineral soil component is high (22.8 %).

In agro–dark–humus gley soils of the rice field, the content and reserve of humus (2.9 % and 90 t/ha, respectively) are lower than in dark-humus gley soils. The humus composition changed: the share of Ca^{2+} –bound HAs increased to the medium level and that of free HAs decreased to very low values. Humus remained of the fulvate–humate type.

In mucky–humus gley soils with acidic conditions, the transformation of organic matter is hampered by anaerobic conditions due to their permanent

overmoistening and low biogeneity. The content of humus in the surface horizons is very high. The surface soil layer is characterized the large humus reserve (165 t/ha), humus is of the humate type. Free HAs and HAs strongly bound to the mineral soil component, whose contents reach medium and high values (48.3 % and 28.1 %) are predominant.

Soils in southern regions of the Far East differ in parameters of humus status. High humus contents have burozems and soddy–eluvial–metamorphic soils. In hydromorphic (deep dark-humus gley) soils, the mineralization of organic residues was delayed. A tendency of increasing humus content and HAs in its composition was traced. In soils of agrogenic landscapes (agro–dark–humus podbels and agro–dark–humus gley soils), the content of humus decreased because of the removal of organic matter of plant origin at the agricultural use of soils.

INFLUENCE OF PHYTOMELIORATION ON HUMUS STATE AND MICROFLORA OF AGRODARK HUMUS–GLEYSOILS IN PRIMORYE

Lyudmila N. PURTOVA, Lyudmila N. SHCHAPOVA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Phytoreclamation is widely applied as an environmentally friendly method of soil fertility reproduction. Replacement of annual grasses with perennial ones contributes to intensification of a biological circulation and increase of soil fertility. In so doing, attention should be paid to changes in soil humus conditions. In view of accelerated mineralization of the organic substance in soils there are considerable reduction of a humus content and change of its quality composition. The aim of this paper is to study changes in indices of soil humus conditions, in agrodarkhumus-gley soils with sowings of phytoameliorants (lucerne, awnless brome, red clover). The object of study are agrodarkhumous-gley soils. Studies were performed on the field of Primorsky Research Institute of Agriculture (Timiryazevsky, Ussuriisk district, Primorye Territory) in a specially designated field test according to the pattern: 1. Control; 2. Lucerne; 3. Awnless brome. 4. Red clover. In the work of the applied physico-chemical research methods used in soil science. To describe the intensity of a humification process we used the indices: the formation movable forms humic acids – a ratio of humic acids of the 1st fraction with relevant fractions of fulvic acids (C_{ha-1}/C_{fa-1}); the intensity of a process of polymerization of humus structures ratio - C_{ha-2}/C_{fa-2} offered by M.F. Ovchinnikova. Study of optical properties of soils connected with humus content – integral reflection (R, %) was performed by using spectrophotometer СФ-18. Catalase activity and soil microflora by generally accepted microbiological methods was determined.

Humus formation in conditions of phytoreclamation in grass took place in conditions of a weak acid medium. Humus content in horizons PU of agrodarkhumus-gley soils complied with a level of low values. On variations with clover and lucerne sowing a slight increase of humus content in comparison with control was recorded. In PU horizons in control and on variations with awnless brome sowing, a nitrogen content (N total) was 0,19 %, lucerne and clover – 0,20 %. C:N ratio corresponded to a level of mean values (9.4–10.2). In superficial horizons with phytoameliorants sowings the humus type changed from humate-fulvate to very fulvate. Among humic acids, fractions bound with Ca^{2+} are basically prevailed, the number of which attained a level of high (variation 1.4) and mean (variations 3.4) values. The number of “free” humic acids on these variations is low and mean. In humification processes, intensity of a polymerization and condensation stage of humus substances is well defined. The strengthening of the formation of humic

acids, judging from the C_{HA-1}/C_{FA-1} ratio, was found out on variation with Lucerne sowing (0,82).

In PU horizons on variations with phytoameliorants sowings, catalase activity attained a level of mean values, which pointed to a high level of soil microflora activity. Predominance of microorganisms assimilating nitrogen mineral compounds over ammonifiers pointed to the high intensity of processes of microbiological mineralization of organic substances in control and awnless brome sowings, which resulted in reduction of humus content.

Reduction of a humus content resulted in the change of optic indices of soils (integral reflection – R). In agrodarkhumous gley soils on control and awnless brome sowings with a lesser humus content, we found out the increase of parameters R from 24.5 % to 27.3 % and 28.0 % respectively.

On the basis of changes of indices of humus conditions, favorable conditions contributing to the increase of soil fertility formed on variations with bean grass sowings (lucerne, clover).

AMMONIA-OXIDIZING BACTERIA RESPOND TO MULTIFACTORIAL GLOBAL CHANGE

Marina L. SIDORENKO

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Human activity is profoundly altering ecological systems. Recent studies have demonstrated that multiple co-occurring global changes can alter the abundance, diversity, and productivity of plant communities. These alterations include increases in atmospheric CO₂ due to fossil-fuel use and land-use change, with subsequent changes in air temperature, precipitation, and the deposition of nitrogen containing compounds. Belowground processes, often mediated by soil microorganisms, are central to the response of these communities to global change. Very little is known, however, about the effects of multiple global changes on microbial communities.

We examined the response of ammonia-oxidizing bacteria (AOB), microorganisms that mediate the transformation of ammonium into nitrite, to simultaneous increases in atmospheric CO₂, precipitation, temperature, and nitrogen deposition, manipulated on the ecosystem level in an agricultural soil. Both the community structure and abundance of AOB responded to these simulated global changes. Increased nitrogen deposition significantly altered the structure of the ammonia-oxidizing community, consistently shifting the community toward dominance by bacteria most closely was most pronounced when temperature and precipitation were not increased. Total abundance of AOB significantly decreased in response increased atmospheric CO₂. This decrease was most pronounced when precipitation was also increased. Shifts in community composition were associated with increases in nitrification, but changes in abundance were not.

These results demonstrate that microbial communities can be consistently altered by global changes and that these changes can have implications for ecosystem function.

EFFECTS OF LONG-TERM FERTILIZER APPLICATIONS ON ACCUMULATION OF CO, CU, NI, AND PB IN SOIL IRON-MANGANESE NODULES

Yana O. TIMOFEEVA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

The trace elements moving along flow vectors in a soil environment encounter a number of migration barriers. One result of their activity is the formation of Fe–Mn nodules, which can selectively uptake trace elements and form microscopic zones with high concentrations in the soil profile. Elements differ in their selectivity for sorption by the Fe–Mn compounds in the nodules. Repeated applications of mineral and/or organic fertilizer may alter the properties of the different phase of soils that controlled accumulation of trace elements and will probably affect the properties of the major Fe–Mn compounds in the nodules and of their associated elements but only a limited number of observations are available. In this work, we present results of accumulation selected trace elements in nodules study with soil from the various fertilizer treatments that have been in operation for more than 70 years. We studied nodules using energy dispersive X-ray fluorescence spectroscopy, atomic absorption spectrometry, electron probe microanalysis, and field-emission scanning electron microscopy. Mean contents of Co (19 mg kg^{-1}), Cu (17 mg kg^{-1}), Ni (35 mg kg^{-1}), and Pb (21 mg kg^{-1}) in studied untreated control soils are lower than regional mean background contents of elements in agricultural soils. The contents of studied elements increased from 2.3 to 3.5 times in soils with fertilizer treatments. Investigations of the depth profiles demonstrated that the concentrations of Ni, Cu, and Co were the highest at surface horizon. The concentration of Pb increased with depth, and the highest amount was found in the middle part of the soil profile. The nodules consisted of a complex Mn–Fe–oxide matrix, soil mineral grains, and C-rich areas. A comparison of the elements contents in the soil horizons and in the nodules suggests a considerable accumulation of studied elements in the nodules. Data on the redistribution of elements through soils profiles show that nodules contain up to 86 % of the total pool of soil Co; from 43 to 70 % of Ni; from 23 to 54 % of Cu, and Pb with the highest values of enrichment factor of studied elements in nodules from soils with long-term various fertilizer treatments. The concentration of acid- and water-soluble forms of elements in the fertilizer treatments soils increases from 20 to 40 % compared with the untreated control soils, which is related to the additional input of elements with different fertilizers and to certain changes in the physico-chemical soil properties resulting in the transformation of difficultly soluble elements-containing compounds into more mobile compounds. At the same time, the concentration of acid- and water-soluble forms of all the elements in the nodules from the fertilizer treatments

soils decreases. The associations of elements in the nodules formed in untreated control soils indicated that the concentrations of Co strongly correlated with the amount of Mn. The concentrations of Ni and Pb were significantly correlated to Fe. Copper had a slightly positive correlation with Mn and Fe in nodules. These interelemental relationships changed in soils with fertilizer treatments and accumulation of all studied elements was mainly controlled by Fe-containing compounds of nodules.

STUDY OF THE PROCESSES OF SOIL FORMATION ON THE SUBSTRATA OF MUD VOLCANOES (ON THE EXAMPLE OF THE VOLCANO MAGUNTAN, SAKHALIN ISLAND)

Daria VZOROVA, Valentina TREGUBOVA

Department of Soil Science, Far Eastern Federal University, Vladivostok, Russia

In total there are more than 40 regions with active mud volcanoes in the world. All of them are specific ecosystems, since the main feature of their territories is the strong salinity of primings. This leads to the formation in the field of mud volcanism development of vegetation, distinct from zonal. The vegetation cover of these unique natural objects is poorly understood, although the phenomenon itself is widespread. Even worse is the case with the study of soil cover or more precisely with the study of the properties of the emerging soils.

The study of soil formation on young surfaces, such as substrates of mud volcanoes, is of theoretical and practical interest. Presence in a homogeneous climate of a different age mud volcanic breccia of approximately the same composition with precise dating of eruptions time allows tracing soil formation on the axis of absolute time and also changes in the vegetation cover associated with changes in soil properties.

Currently, three regions of mud volcanism develop on Sakhalin, one in the north and two in the southern part of the island. The largest center is the group of Pugachev mud volcanoes, located in the southern part of the island, which includes the volcano Maguntan. Unfortunately, special works dedicated to the soils of mud volcanoes about Sakhalin was not conducted.

The purpose of this work is to consider the processes of primary soil formation on the substrates of the mud volcano Maguntan.

To achieve the goal of the work, the following tasks were set:

- 1) To study the chemical and physico-chemical properties of the mud volcano substrates in connection with the dynamics of the vegetation composition.
- 2) Compare the properties of primitive soils formed on mud volcanic flows with adjacent zonal soils.

As a result of studying the physical and physicochemical properties of different ages of mud eruptions, we come to the conclusion that with a progressive change in the species composition of plants, geochemical changes and differentiation of soil horizons occur. Flower composition varies from competitive-weak to sustainable zonal species. In turn, with the change of vegetation, we observe changes in the properties of mud substrates, up to the appearance of those characteristic of zonal soils.

But unlike zonal soils, the primitive materials we study, which consist of a clay substrate (C) on which organogenic horizons (O) are formed. In these

soils, important soil-forming processes are the processes of accumulation and insignificant transformation of organic material, which leads to a change in the reaction of the medium, the appearance of humic compounds, predominantly fulvic acids.

Consequently, as the time interval increases from the moment of eruption to the appearance of vegetation comparable to zonal species, the properties of soil substrates change.

They acquire certain features and properties that allow us to speak of the direction of soil formation characteristic of the formation of zonal soil types. But the intensity of the development of these processes, are still weakly expressed.

DISINFECTANT-RESISTANT BACTERIA ENRICHED ON CLEANING TOOLS IN A BACTERIOLOGY LABORATORY IN TAIWAN: WITH A SPECIAL REFERENCE TO SURFACTANT- AND ANTIBIOTIC-RESISTANT *ACINETOBACTER* STRAINS

I-Chen YANG, Shir-Ly HUANG

Institute of Microbiology and Immunology, National Yang Ming University, Taipei, Taiwan

In Taiwan, approximately 3,500 individuals annually suffer from hospital-acquired infections that happens in hospitals or other health care facilities. Nosocomial infections were difficult to recover because higher number of antibiotic-resistance bacteria were found. Although hospital staffs or visitors are able to reduce the risk by washing hands and changing gloves frequently. In addition, medical equipment and public facilities need to be cleaned frequently or going to become the biggest problem related to the spread of pathogens in hospitals.

Before investigating hospital samples, the disinfectant-resistant bacterial strains were first isolated from mop using sodium hypochlorite in a bacteriology laboratory on university campus. In this study, both cultivation-independent and dependent methods were used to analyze the bacterial communities in laboratory mops. Disinfectant-used mop (1% commercial detergent and bleach water) was compared with water-used mop. High-throughput sequencing of 16S rRNA gene represents bacterial communities in mops. Relative abundance changes in disinfectant used mop as Proteobacteria was increased, from 42.8% to 99.1%, Actinobacteria, from 6.4% to 0.4%, and Bacteroidetes, from 39.2% to 0.2%. Among Proteobacteria in disinfectant-used mop, two genera *Acinetobacter* (80% in relative abundance) and *Moraxella* are dominant. The two genera are both considered as common pathogens in nosocomial infections. By using cultivation-dependent method, 85 strains were isolated and tested in the following conditions: (1) the catabolism of 0.1% and 0.5% ethoxylated surfactants as sole carbon source; (2) the tolerance to 500 ppm sodium hypochlorite; (3) the tolerance to antibiotics (8 µg/ml ampicillin, 16 µg/ml gentamicin or 32 µg/ml kanamycin). Three *Acinetobacter* sp. strains were shown to be able to utilize Triton-series surfactants or PEG400 as sole carbon source. They also resist to ampicillin. Two isolates that are able to utilize Triton X-165 as sole carbon source effectively were identified as *Bacillus* sp. In addition, *A. lwoffii*, *A. johnsonii*, *A. baumannii*, *Moraxella osloensis* and *Corynebacterium tuberculostearicum* were also demonstrated to be enriched in our mops samples. *A. johnsonii*, *A. baumannii*, *M. osloensis* was repeated to be detected in kitchen sponges by other team in Germany. *Moraxella* sp. and *Corynebacterium* sp. were detected on the surface in wards in a community hospital in Taiwan. Because the disinfectant used in hospitals are similar as we tested, this study provides a preliminary investigation of the disinfectant-resistance bacteria in laboratory mops and further sampling of hospital cleaning tools will be conducted.

CHANGES IN POTASSIUM STATUS AT THE MINERAL FERTILIZERS AND LIME APPLICATION

Elena A. ZHARIKOVA

Federal Scientific Center of the East Asia Terrestrial Biodiversity, FEB RAS, Vladivostok, Russia

Potassium (K) is the essential plant nutrients after nitrogen and phosphorus. The availability of K differs greatly with soil type and is affected by physicochemical properties of the soil. Most of Primorie soils have an average quantity of exchangeable potassium and need liming. Potassium mobilization/fixation during liming and fertilizers application is significantly affecting K availability.

Effect of mineral fertilization and liming on the K-fixing and Q/I parameters of Umbric Cambisols, Albic Luvisols and Albic Stagnosols was studied under laboratory experiments.

Potash fertilizers increased the quantities of water extractable K, exchangeable K, slowly-exchangeable K and equilibrium K concentration ratio (CR_0) and reduced potential buffering capacity of K (PBC^K). Liming enhanced the potassium fixation in all soils, but to varying degrees. Differences in potassium fixation were related to the texture and mineralogy of soils. Albic Luvisols and Stagnosols Albic enriched in clay minerals and fine fractions, so high fixation of K^+ ions in these soils suggests that the role of clays in stocking potassium is important for the long term conservation of this element. Umbric Cambisols have low fixation capacity, so the fractional application of K fertilizers is more effective.