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**The East Asian Flora
and its role in the formation
of the world's vegetation**

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A circumpolar comparison of terricolous lichens in East Asian boreal vegetation and flora

Teuvo T. AHTI

Finnish Museum of Natural History, Helsinki, Finland

Ахти Т. Т. Циркумпольярное сравнение напочвенных лишайников в растительности и флоре Восточной Азии

Terricolous, fruticose lichens are dominant members in the ground layer of xeric, open woodlands in extensive areas of continental sectors of the boreal zone in East Asia. Certain species are also common in the bryophyte-dominated mesic and submesic community types. In addition, lichens are often dominant on thin soil over open rock outcrops, in boulder fields, on sand-dunes, and on hummocks or even wet surfaces of peatlands. Their remarkable ecological role tends to increase towards the polar or alpine timberlines and in various forest successions on well-drained soil, but also on peatlands after forest fires or logging, then binding humus and parent soil against erosion, and forming lichen-rich, seral communities. The major lichen species in East Asian vegetation are largely circumpolar (e.g., *Cladonia stellaris*), occupying similar sites and subzones elsewhere in the circumboreal zone. Another element is present in all four boreal coastal regions (e.g., *Cladonia maxima*). The East Asian element is small, including *Cladonia cineracea* and some coastal species. The Amphiberingian element includes *Cladonia alaskana*, *C. alinii*, *C. jacutica*, *C. kanewskii*, *C. nipponica*, *C. pseudoevansii*, *C. scotteri*, and *Flavocetraria minuscula*. *Cetraria laevigata* and *Cladonia wainioi* occupy similar ecological niches extending to eastern North America. The arid boreal sectors (as in the Sakha Republic) include areas where calcicolous, primarily arctic or steppe lichens may form soil crusts with numerous tiny crustose species.

Primary study of *Xanthoceras sorbifolia* seeds originating from Inner Mongolia and Liaoning, China

Chanhoon AN, Hyunseok LEE & Jaeseon YI

Kangwon National University, Chuncheon, Republic of Korea

Ан Ч., Ли Х., Йи Дж. Предварительное исследование семян *Xanthoceras sorbifolia* из провинций Внутренняя Монголия и Ляонин, Китай

Xanthoceras sorbifolia Bunge, the sole species in the genus *Xanthoceras*, is a flowering plant in the family Sapindaceae. It is known as yellowhorn, shiny leaf yellowhorn, goldenhorn, or Chinese flowing chestnut in English and is native to northern China in the provinces of Gansu, Hebei, Henan, Liaoning, Inner Mongolia, Ningxia, Shaanxi, and Shandong. It is an important tree species being a source of edible oil and biodiesel with a capacity as a pioneer of degraded and desert land. Seeds of *X. sorbifolia* were collected from two plantations and two superior trees in Inner Mongolia; and one plantation and one superior tree in Liaoning, China in late August, 2011. Traits of seeds varied considerably between and among areas, for example two trees produced quite different seeds in several traits, although they are adjacent to each other in the same farm. Weight of 1 000 seeds varied from 718 g to 1 010 g and volume from 0.76 L to 1.52 L. Weights of one-liter seeds were 522 g to 688 g, while the number of seeds were 603 to 935. Seeds from Qingsonglingxiang No.1 showed the highest germination rate followed by Lindonglinchang. As much attention has not been paid to the traits of seeds, there should be a genetic test to understand this variation. It is necessary to obtain information on seed characteristics first and then provide basic information for further research on the selection of superior trees and provenances.

Towards definition of the Dahurian flora

Konstantin S. BAIKOV

Institute of Soil Science and Agrochemistry SB RAS, Novosibirsk, Russia

Байков К. С. К определению Даурской флоры

Differing points of view on the status and division of the Dahurian flora and its boundaries are considered in detail. The Dahurian flora is represented as an association of three florogenetic complexes: meadow-forest Mandshurian, mountain-forest East Siberian and dry steppe North Mongolian. The determination of external boundaries of the Dahurian flora depends on a choice of the concrete complex as a floristic kernel (dominant). The concept of the Hingan-Yablonovyi-Hentei cascade phenomenon through the transfer of damp Pacific Ocean air midland, may also influence physico-geographical limits of the Dahurian flora. As a result, Dahuria as naturally occurring florogenetic entity is therefore placed in a pool of northern (left) inflows of the Upper Amur river. The Amurian flora is thus florogenetic, presenting transitional features from the boreal megafloora of the East Siberian type to warm-temperate megafloora of the East Asian type. The florogenetic profile of Dahuria includes three floristic groups of a steppe element: forest-steppe, steppe and mountain-steppe. Each of these in different areas of the Dahurian flora consists of 80 to 140 species. Here the focus is on the area of shrubs (*Ulmus macrocarpa*, *Securinega suffruticosa*, *Lespedeza* spp., *Rhamnus*, *Cotoneaster*, *Fraxinus*, *Viburnum*, *Spiraea*, *Rosa* and *Armeniaca sibirica*) and some perennial herbs (*Euphorbia fisheriana*, *Pardanthopsis dichotoma*, *Paeonia lactiflora*, *Dictamnus dasycarpus* etc.). The main cause of divergence between the Dahurian and Mandshurian flora is the Big Hingan Mountains – the great boundary in the Hingan-Yablonovyi-Hentei cascade with a defined rain shadow that reflects a sharp boundary within the gradient of the Pacific Ocean moisture transfer. A more detailed definition of internal elements of the Dahurian flora will require the application of the basin principle and a hierarchical description of land ecosystems.

Hepatic distribution patterns in the Russian Far East

Vadim A. BAKALIN^{1,2}

¹ Botanical Garden-Institute FEB RAS, Vladivostok, Russia

² Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

Бакалин В. А. Закономерности распределения печеночников на российском Дальнем Востоке

The liverwort flora of the Russian Far East is the most taxonomically diverse regional flora within Russia including 405 species, or ca. 80 % of total hepatic diversity. Almost 14 % (55 species) are known in Russia from this region only. The main reasons underlying high hepatic diversity are: the strong diversity of thermal regimes and humidity conditions in the Russian Far East, diverse orography and degree of geological stability, the absence of continuous ice cover in most parts of territory during the Cenozoic glaciations and wide distribution of modern glaciers, and the close modern and ancient floristic contacts between this territory and North America, East Siberia and Southeast Asia. Many taxa have limited distribution in the Russian Far East: namely northern, southern and western, or else are either known in localities isolated from the main area body, or are endemics. The floras of landmasses with continental and oceanic climates are predictably different. Species richness in the insular and peninsular parts of the Far East is ca. 5 times that of the continental part. The increasing proportion of Temperate species from the North to the South and a parallel decrease of Arctic species is obvious, but in the insular part these changes are not as evident as in the continental section. The species diversity exhibits unique centers of concentration, but is unevenly distributed within the Russian Far East. The highest number of species is recorded in the mountainous region of the central Sredinnyj Range in Kamchatka, the eastern Chukotka Peninsula, the southern Vostochno-Sakhalinskiye mountains, in Sakhalin Island, the southern flank of Sikhote-Alin Range, and South Kurile Islands. Another likely center of diversity in the Russian Far East is the coastal range westward of Sea of Okhotsk where, unfortunately, the hepatics have not yet been studied.

Phylogeny of the genus *Salix* L. (Salicaceae) in the Russian Far East

Vyacheslav Yu. BARKALOV^{1,2} & Marina M. KOZYRENKO¹

¹ Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

² Botanical Garden-Institute FEB RAS, Vladivostok, Russia

Баркалов В. Ю., Козыренко М. М. Филогения рода *Salix* L. (Salicaceae) на российском Дальнем Востоке

Recent studies based on sequencing nuclear and chloroplast DNA genomes show that genera *Salix*, *Toisusu* and *Chosenia* form a monophyletic group. Evolutionary relationships in this group still remain arguable. To determine phylogenetic relationships in the genus *Salix* we researched ITS of an nDNA region and 7 chDNA regions. Nucleotide sequence analysis of ITS region did not allow us to solve relationships of species in the genus, except for the big subgenus *Salix* (sections *Amygdalinae*, *Urbanianae*, *Pentandrae*, *Salix*, *Subalbae*, *Longifolia*). 11 chDNA regions showed irregular variation. The *rbcL* gene part proved to be the most conservative: all researched *Salix* species in NE Asia had the same sequence. Most variable were the regions of *trnD-trnT* and *rpoB-trnC*. Overall length of combined sequences of studied chDNA regions (including indels) was 7 408 pm (5 % of a plastid genome) for each sample. ChDNA variation in researched taxa is low. We discovered 193 variable sites (2.6 %), of which 95 were informative according to the Method of Maximum Parsimony and 98 uninformative. Analysis of 66 sequences revealed 56 haplotypes of which 52 are unique. 14 species in subgenera *Chamaetia* and *Vetrix* have the same haplotype. Largest genetic distance is between *S. nipponica* and *S. pseudopentandra* (0.014). Molecular differences were found only among species of subgenus *Salix*, showing high divergence of their chloroplast genomes. The high similarity of sequences in chDNA and ITS region, found in most *Salix* species, may provide evidence of their recent and rapid divergence from a common ancestor, as well as of a high level of interspecies hybridization.

Structural-biological peculiarities of the species of the genus *Corydalis* Vent. in the Russian Far East

Tamara A. BEZDELEVA

Botanical Garden-Institute FEB RAS, Vladivostok, Russia

Безделева Т. А. Структурно-биологические особенности видов рода *Corydalis* Vent. на российском Дальнем Востоке

The genus *Corydalis* (Papaveraceae) in the flora of the Russian Far East is represented by 21 species classified into 7 sections according to Popov and is characterized by a diverse life forms. The section *Archaeocapnos* is represented by six seasonal, summer-green species. The generative individuals form tufts up to 3-4 m diameter with a taproot and three kinds of rhizomes. The primary root often persists during the life of an individual. The monocarpic shoots are semi-rosette, polycyclic, growing in a monopodial manner during several (up to 14) years and form rosette shoots bearing 1 large rosette leaf up to 50 cm (or longer) every year. An annual vegetative shoot has elongated, branches, 40-100 cm high. The section *Ceratotuber* includes one species, *C. buschii* that is a spring- and summergreen forest ephemeroïd, tuberous-stoloniferous herbaceous polycarpic plant, and a vegetative annual geophyte. It has a tuber with 1-4 stolons underground. The apical bud of a stolon develops into an elongated vegetative or generative annual shoot. The daughter tuberous-stoloniferous structures are formed at the bases of both vegetative and generative shoots. The tuber of *C. buschii* is compound and consists of a shoot base and thickened stoloniferous bases. The generative plant is a tuft up to 25-30 cm diameter. The section *Pes-gallinaceus* is represented by 6 species. These plants are spring-green ephemeroïds. All species of this section are tuberous geophytes. The tuber is replaced annually by one which is formed within the former tuber. The shoots in species of the section *Pes-gallinaceus* are elongated up to 5-25 cm long and bear 3-4 scaly leaves at the bases, one scaly leaf at a certain distance from lower scaly leaves, two median assimilative leaves, with a terminal inflorescence. *C. remota* differs from other species of the section *Pes-gallinaceus* in the formation of two life forms, namely tuberous and tuberous-stoloniferous geophytes. The species of *Sophorocapnos* section are annual to biennial tap-rooted monocarpic plants with a semi-rosette shoot. The species of *Microcapnos* section are tap-rooted annual monocarpic plants with an elongated shoot.

Aquatic plants in the northern Russian Far East: problems and perspectives

Alexander A. BOBROV¹ & Olga A. MOCHALOVA²

¹ Papanin Institute for Biology of Inland Waters RAS, Borok, Russia

² Institute of Biological Problems of the North FEB RAS, Magadan, Russia

Бобров А. А., Мочалова О. А. Водные растения на российском Дальнем Востоке: проблемы и перспективы

Aquatic plants in the north of the Russian Far East (RFE) are still poorly studied and knowledge about them differs between regions. The most problematic genera are *Potamogeton*, *Batrachium* and *Sparganium*. In *Potamogeton* there are questions on status of some taxa, their relations with close species, e.g. *P. borealis* with *P. filiformis*, *P. subsibiricus* and *P. anadyrensis* with *P. sibiricus*, and *P. tenuifolius* with *P. alpinus*. North American *P. richardsonii* and *P. strictifolius* occur in the area. It is of interest how widely these species are spread. Tropical *P. fryeri*, *P. digynus*, *P. distinctus* are recorded here. Are these records correct? What promotes their preservation under these conditions? Also hybrid activity study in this genus is important. *Batrachium circinatum*, *B. kauffmannii* and *B. trichophyllum* are common in the northern RFE. Other taxa need studying. Is real *B. eradicatum* presented here or it is a small form of other species? Heterophyllous *B. mongolicum* (*B. setosissimum*), and its relation with close European *B. aquatile*, *B. floribundum* and Japanese *B. nipponicum* are interesting. What is the large river form similar to *B. pseudofluitans*, mentioned here as *B. ashibetsuense* and *B. yezoense*? Besides *Sparganium angustifolium*, *S. emersum*, *S. glomeratum*, *S. gramineum*, *S. hyperboreum*, *S. natans*, 1 (possibly 2) taxa of hybrid origin occur. It is a stabilized hybrid of *S. emersum* or little-known *S. probatovii* described from Koryakiya. Other hybrids in this genus can be expected. It is necessary to pay attention to genera *Callitriche*, *Myriophyllum*, *Utricularia* and some others. The status of *Callitriche subanceps* is unclear. The distribution and relationship between *Myriophyllum sibiricum* and *M. spicatum* in the region is an open question. *Utricularia stygia*, a new species for the Asiatic part of Russia, has been discovered recently in the northern RFE. Cryptogamic macrophytes (freshwater macroalgae and bryophytes) require special investigation. These plants are seldom taken into account in hydrobotanical studies, however in some aquatic ecosystems they form the core of macrophytic vegetation. The study is supported by grants of RFBR no. 12-04-00074, 12-04-00904.

***Sauteria* Nees and *Peltolepis* Lindb. (Cleveaceae, Marchantiophyta) in the Russian Far East**

Eugene A. BOROVICHEV & Nadezhda A. KONSTANTINOVA

Polar-Alpine Botanical Garden-Institute, Kola Sci. Centre RAS, Apatity, Russia

Боровичев Е. А., Константинова Н. А. *Sauteria* Nees и *Peltolepis* Lindb. (Cleveaceae, Marchantiales) на российском Дальнем Востоке

The genera *Sauteria* Nees and *Peltolepis* Lindb. (Cleveaceae, Marchantiales) have been revised for the Far East of Russia. In total, 45 specimens from KPABG, LE and VLA were studied. Previously two species of *Sauteria* were reported from the Far East of Russia: *S. alpina* (Nees) Nees and *S. japonica* (Shimizu & S. Hatt.) S. Hatt. *S. japonica* was recorded for Russia by V. Bakalin (Bakalin et al. 2009) from two localities in Sakhalin Province. Plants from these specimens have a spongy texture, 2-3 layers of air-chambers and a male receptacle on ventral but unreduced branches. A more or less spongy texture and male ventral branches are not rare in European specimens of *S. alpina*. So we suggest that these specimens should be referred to *S. alpina* and *S. japonica* should be excluded from the flora of Russia. *S. alpina* is an arcto-alpine circumpolar species. *S. alpina* is sporadically distributed in the Far East of Russia. It is known in the Chukotka Autonomous Area, Kamchatka Province, Sakhalin Province (Paramushir and Sakhalin Islands). In the Russian Far East two species of *Peltolepis* were known: *P. quadrata* (Saut.) Müll. Frib. and *P. japonica* (Shimizu & S. Hatt.) S. Hatt. Recently, Rubasinghe (2011) synonymized the latter with *P. quadrata*. Nevertheless based on morphology *P. japonica* is distinguished at the variety level as *P. quadrata* var. *japonica* Shimizu & S. Hatt. It differs from a type variety by a smaller size, not firm texture, shape and colour of ventral scales. On the other hand structure of carpocephalum, that were regarded as diagnostic features by Shimizu & Hattori (1954, 1955), are very variable and do not allow to distinguish these taxa. *P. quadrata* is an arcto-alpine circumpolar species. It is recorded in the Russian Far East from Chukotka Autonomous Area, Kamchatka Province (Eastern Kamchatka and Commander Island), Sakhalin Province (Sakhalin Island only). *P. quadrata* var. *japonica* is an eastern-asiatic species restricted to Russia, Japan and China. It is known in Russia from two localities in Primorskii Territory only. The work was partly supported by the Russian Foundation for Basic Research, grant no. 10-04-00050.

The Late Jurassic – Early Cretaceous and Paleocene swamp plant communities of Transbaikalia and the Russian Far East

Eugenia V. BUGDAEVA & Valentina S. MARKEVICH

Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

Бугдаева Е. В., Маркевич В. С. Позднеюрские – раннемеловые и палеоценовые болотные растительные сообщества Забайкалья и Дальнего Востока

On the territory of Transbaikalia, Amur River region, and Primorye region three stages of development of swamp vegetation, where the abundant plant material accumulated, can be distinguished: the Tithonian-Valanginian, the Barremian-Albian, and the Paleocene. The main Tithonian-Valanginian coal-forming plants were cyatheaceous ferns, conifers, and extinct ginkgoaleans (*Pseudotorellia*, *Eretmophyllum*, and *Sphenobaiera*). The coal formation at the second stage was the most significant being manifested over vast areas of Siberia and the Far East. During the Barremian-Albian, the main coal-forming plants varied in composition depending on environments: in sea-side marshy plains they were represented by gleicheniaceous and cyatheaceous ferns, as well as taxodialeans, in intracontinental basins - cyatheaceous ferns, conifers (Miroviaceae, Cheirolepidiaceae, Araucariaceae, and Pinaceae) and ginkgoaleans (*Baierella*, *Sphenobaiera*, *Pseudotorellia*). The coal accumulation of the third stage took place in Zeya-Bureya Basin (Amur River region). The mire plant communities were dominated by taxodialeans and polypodiaceous ferns. The composition of the Jurassic and Cretaceous mire communities shows their conservatism, probably due to similar palaeoenvironments. Conifers and ginkgoaleans were critically important elements of swamp plant communities. Nevertheless, at the Mesozoic-Cenozoic boundary their composition changed drastically. Miroviaceae, Cheirolepidiaceae, and ginkgoaleans disappeared. Taxodialeans replaced them in swamp plant communities. Our research was supported by Russian Academy of Sciences (grant № 12-I-P28-01), Far East Branch of RAS (grant 12-III-A-06-075, 12-III-A-06-070).

Soil matters: measured soil variables explain significant variation of tree beta-diversity in forest permanent plots (Lienhuachih, Taiwan)

Li-Wan CHANG¹, David ZELENÝ², Ching-Feng LI², Shau-Ting CHIU³
& Chang-Fu HSIEH¹

¹ National Taiwan University, Taipei, Taiwan

² Masaryk University, Brno, Czech Republic

³ Taiwan National Museum of Natural Science, Taichung, Taiwan

Чанг Л.-В., Зеленый Д., Ли Ч.-Ф., Чiu Ш.-Т., Хсие Ч.-Ф. О важности почв: переменные, основанные на почвенных измерениях, объясняют статистически значимую вариацию бета-разнообразия деревьев на лесных постоянных площадях (Линхуачих, Тайвань)

Recently, several studies used forest permanent plots, established within the framework of Center for Tropical Forest Science, to investigate the beta-diversity pattern of forest vegetation in tropical, subtropical and temperate zones. Topographical variables, which are available for all permanent plots, are usually the only environmental factors used in these studies, although it is acknowledged that topography influences the vegetation mostly indirectly via soil properties. This issue becomes important especially in studies focusing on variance partitioning of beta-diversity among environmental and spatial components and comparison of their proportions, aimed to disentangle the importance of niche and neutral assembly in plant communities where we expect that available environmental factors are sufficient for describing the environmental control of species composition. We focused on two questions: 1) how does the variation in species composition explained by environment increase when soil variables are included into analysis along to topographical variables, and 2) which topographical and soil variables, respectively, are redundant (i.e. highly correlated with others) and which are not. We used the data from the 25 ha forest permanent plot in Lienhuachih, located in central Taiwan, where we measured 4 topographical and 16 soil parameters from soil samples collected in each of 625 grid cells. As a result, we found that including soil data as explanatory variables along to topographical factors is more than twice the variation explained by environment. The most important soil variable in Lienhuachih is C/N ratio, and the most important topographical variable is convexity. We conclude that soil variables, although partly correlated to topography, play an important role in explaining variation in species composition.

Invasion of *Solidago canadensis* is causing biotic homogenization in China

Guo Qi CHEN¹, Chao Bin ZHANG¹, Ling MA¹, Sheng QIANG¹,
John A. SILANDER² & Li Li QI³

¹ Weed Research Laboratory, Nanjing Agricultural University, Nanjing, China

² University of Connecticut, Storrs, CT, USA

³ Northern Crop Science Laboratory, USDA-ARS, North Dakota 58105, USA

Чен Г. Ч., Жанг Ч. Б., Ма Л., Чянг Ш., Силандер Дж. А., Чи Л. Л. Инвазия *Solidago canadensis* вызывает гомогенизацию биоты в Китае

Serious invasive species may directly and quickly cause biotic homogenization. Here we quantitatively compared the communities invaded by *Solidago canadensis* (SC) with the control sites adjacent to these populations but without it in China and those with SC native populations in America through field-surveys. We found that SC invasions cause invaded habitats to share similar plant communities with those in native ranges which are characterized by SC being dominant, significantly lower species richness and α - and β - diversity, as well as a decrease in correlations between geographic distance and floristic similarities. Analyses on Bray-Curtis similarity (based on species abundance) suggests the sites with SC invasive populations clustered together with those with native SC populations but not with adjacent control sites. While the Jaccard similarity (based on species list) suggest there is no common co-prosperous plant invader in the communities with SC invasive populations. Although SC favors fertile loam soil conditions, it homogenizes various habitats with large populations.

Using suballiances of the *Machilus-Castanopsis* forest zone to delimit the geographical climatic regions of Taiwan

Tze-Ying CHEN¹, Tzung-Tai HUNG¹, Ching-Feng LI² & Chiou-Feng YU³

¹ National Yilan University, Yilan, Taiwan

² Masaryk University, Brno, Czech Republic

³ Council of Agriculture, Taipei, Taiwan

Чен Т.-Й., Хунг Ц.-Т., Ли Ч.-Ф., Ю Ч.-Ф. Использование подсоюзов лесной зоны *Machilus-Castanopsis* для разграничения климатических районов Тайваня

Hong-Jye Su analyzed the weather stations in Taiwan to group them into geographical climatic regions. The amount of water deficiency and the duration of dry season had been considered in the analysis. The result divided the geographical climatic regions into 7 parts: northeast region, northwest region, central west region, southwest region, southeast region, east region and Lanyu region. The first two regions were of everwet climate type, while other regions showed various degrees of summer rain type (monsoon climate). Then compared with the altitudinal vegetation zones we found that the *Machilus-Castanopsis* forest zone were widely distributed in Taiwan, resulting in the division of the geographical climatic regions more clearly than the other zones. We analyzed the data of 2 286 plots for vegetation classification of *Machilus-Castanopsis* forest zone in Taiwan. The vegetation classification results in 47 subassociations and 18 associations, which can be grouped into 8 suballiances, including *Schimenion kankaoensis*, *Neolitsenion parvigemmae*, *Ormosienion formosanae*, *Castanopsenion sessilis*, *Turpinienion ternatae*, *Ficenion irisanae*, *Litsenion acuminatae* and *Dendrocnidion meyeniana*. The first five suballiances belong to mid-slope and ridge type, and the last three alliances are a valley type. This study found that the alliances of the valley type are evenly distributed in Taiwan, including *Ficenion irisanae*, which are distributed in the northeast region, northwest region and central west region; *Litsenion acuminatae* are evenly distributed in Taiwan; *Dendrocnidion meyeniana* are distributed in the southwest region, southeast region and east region. But the suballiances of mid-slope and ridge type can be used to divide Su's geographic climatic regions clearly. *Castanopsenion sessilis* are distributed in the Northeast region, *Ormosenion formosanae* in the Central west region, *Turpinienion ternatae* in the East region, *Neolitsenion parvigemmae* in the Southwest region, and *Schimenion kankaoensis* in the Southeast region and Hengchun Peninsula.

The moss flora of the Primorsky Territory (Russian Far East)

Valentina Ya. CHERDANTSEVA¹ & Konstantin V. GOROBETS²

¹ Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

² Far Eastern Federal University, Vladivostok, Russia

Черданцева В. Я., Горобец К. В. Флора мхов Приморского края (Российский Дальний Восток)

At present, 474 taxa of mosses belonging to 189 genera and 56 families are known from the Primorsky Territory (PT). The spectra of genera and families in their main parts are typical of temperate flora. The greatest number of species occurs in the forest, on various substrata, including the bark of living and dead trees, decaying wood, soil, stones and rocks. About 65–66 % of the moss flora is represented by species with wide holarctic or disjunctive holarctic ranges. Species with more limited distributions number about 30 %. These are almost exclusively East Asian and East Asian – North American species; many of which are widespread over the south of the Russian Far East and play a great phytocoenotical role not only in the Machurian but also in coniferous forest types. In comparison to the moss floras of other regions of Russia the moss flora of PT is also characterized by high specificity. Thus, approximately 115 species (24 %) and 26 genera (about 14 %) occur in the Russian Far East, among those 8 genera (*Dicranoloma*, *Homaliadelphus*, *Meteorium*, *Miyabea*, *Pseudoleskeopsis*, etc.) and 36 species (*Anomodon solovjovii*, *Entodon giraldii*, *Forsstroemia trichomitria*, *Lindbergia sinensis*, etc.) occur in Russia in the PT only. Truly endemic species, which usually testify to flora's origin, are very few in the moss flora of the studied region. At present there are 6 endemic species (*Brachymenium exiloides*, *Coscinodon pseudohartzii*, *Entodon rufescens*, *Forsstroemia stricta*, *Lindbergia geniculata*, *Plagiothecium cordifolium*). The bryoflora of the PT is very similar to that of the northern Japan, adjacent provinces of China and Korean Peninsula.

The invasive species of Kamchatka's flora

Olga A. CHERNYAGINA¹ & Lisa V. STRECKER²

¹ Kamchatka Branch of Pacific Institute of Geography FEB RAS,
Petropavlovsk-Kamchatsky, Russia

² Department of Anthropology, University of Alaska, Fairbanks, USA

Черныгина О. А., Штрекер Л. В. Инвазионные виды Камчатской флоры

In the flora of Kamchatka peninsula there are 1200 known species and subspecies of plants. In the "Catalogue of Kamchatka's Flora" (2004) 183 of them are adventive. For some years past we observed that some of these species settled in the southern part of Kamchatka successfully. In Petropavlovsk-Kamchatsky and in the surrounding settlements *Impatiens balsamina* L., *Knautia arvensis* (L.) Coult., *Pilosella aurantiaca* (L.) F. Schultz et Sch. Bip., *Pilosella x floribunda* (Wimm. et Grab.) Fries, *Tussilago farfara* L. and *Arctium lappa* L. form the monodominant communities in waste areas most conspicuously at flowering time. Notably, in 1980's all these species was not registered in the Kamchatkan flora. In 2010 we recorded *Heracleum sosnowskyi* Manden in Kamchatka for the first time. This species occurs as an extensive weed on the southern slopes of the maritime area of the town and takes up wide areas in the Valley of the Paratunka river, where the species became naturalized on the warm soils near the reservoirs, chinks and pipelines, which are typical for these districts, where water of the Paratunka geothermal layer is used for house-heating, greenhouse-heating and balneology. The question about the potential naturalization of these widely dispersed species near the hot springs of Kamchatka and their further expansion across the whole peninsula is already reviewed in scientific literature. *Heracleum sosnowskyi* is the first and unique example, that confirms this supposition. Formerly we repeatedly noted, that carried (by men or by birds) to the hot springs species don't leave the warm soils near the springs and don't invade the peninsula (although there are active species like *Echinochloa crusgalli* (L.) Beauv.). The distribution of the adventive species within the peninsula should be logically connected with expanding road networks and with people's activities of the plots of land attached to households. Already we know of the rapid expansion of a number of species that are traditionally grown in Petropavlovsk-Kamchatsky for ornamental purposes (*Lupinus polyphyllus* Lindl., *Symphytum caucasicum* Bieb., *Solidago canadensis* L.).

Anthropogenic dynamics of sub-climax forests of the southern Russian Far East

Margarita N. CHIPIZUBOVA¹, Viktor M. URUSOV², Boris S. PETROPAVLOVSKY³

¹ Pacific Institute of Geography FEB RAS, Vladivostok, Russia

² Far Eastern Federal University, Vladivostok, Russia

³ Botanical Garden-Institute FEB RAS, Vladivostok, Russia

Чипизубова М. Н., Урусов В. М., Петропавловский Б. С. Антропогенная динамика субклимаксовых лесов российского Дальнего Востока

Reduction of forest cover of the most complex conifer-broadleaf forests of the Russian Far East, traced through pollen-spore spectra, and also through old-growth trees and their remnants testifies to a slow regeneration of the forest even with reduced human activity. Reduced human activity did not lead to a regeneration of sub-climax forests in broad river valleys and on slopes up to the first hundred meters in altitude above sea level. By studying the age of a large quantity of *Taxus cuspidata* (from 1 500 years on the islands in Peter the Great Bay in the Sea of Japan, to 800 years and about 500 years old on the coast), and the age of large stems of *Betula schmidtii* in the Nature Reserve "Kedrovaya Pad", we calculated a reduction of fires about 1500 years ago on the islands, and about 800 and 400 years ago on the mainland. From the 18th century to 1860 forest cover in Primorsky region increased to 75 %, and conifer and conifer-broadleaf forests occupied 57.3 % of the territory versus, respectively, 62 % and 32 % in 2001. Reserves of timber in coniferous forests on average fell by not less than 1/3. Sub-climax ecosystems of *Abies holophylla*, and *Pinus koraiensis* were preserved on not more than 15 % of the area occupied by these formations.

Phytogeographical pattern of the Baikal-Dzhugdzhurian alpine flora

Sergey V. DUDOV

Moscow state university, Moscow, Russia

Дудов С. В. Фитогеографические закономерности Байкало-Джугджурской флоры

The Baikal-Dzhugdzhurian province (Sochava 1962), includes the Baikal and Stanovoe Uplands, Stanovoy Range and ranges of Dzhugdzhur-Stanovoy orogen (Tokinskiy Stanovik, Dzhugdzhur, Pribrezhniy, etc.) and stretches for more than 1600 km inland from the sea of Okhotsk. According to several floristic studies the concerned territory is an important migration route for many vascular plant species and their complexes during Quaternary period climatic changes. Add to this, a mixture of different florogenetic alpine species complexes takes place, with continental eastern-Siberian, Beringian and southern-Siberian complexes among them. The Baikal-Dzhugdzhurian province can be considered as a one whole phytochorion due to the presence of a number of endemic species (*Salix divaricata* subsp. *kalarica*, *Saussurea poljakovii*, *Claytonia udocanica*, *Taraxacum mujense*, *Saxifraga algisii*, *S. svetlanae*, *S. staminosa*, *Calamagrostis kalarica*) and an endemic monotypic genus *Borodinia*. The study aims to specify the spatial differentiation frontiers of the Baikal-Dzhugdzhurian province alpine species. The following goals are: to compile the territory alpine flora data base, to evaluate the role of abiotic environmental factors in the alpine flora differentiation process and to develop a regionalization scheme. A Baikal-Dzhugdzhurian province alpine flora database was compiled using reported data from herbarium material and own field material, collected within Dzhugdzhur, Geran and Tukuringra mountain ranges. It includes more than 840 plant species from above the tree line. This number includes 550 distinct alpine species and almost 300 mountain and additional species, which penetrate from lower altitudinal belts. As a result the territory is divided into 16 regions corresponding with the main mountain ranges of Baikal-Dzhugdzhurian province, floristic information about which is available. A phytogeographical regionalization scheme including four major alpine floristic regions was compiled using data from published regional floras, remote sensing, digital elevation and, climatic and geologic data.

Subdivisions of dark coniferous forests of North Eurasia for a Circumboreal vegetation map

Nikolai B. ERMAKOV

Central Siberian Botanical Garden, Novosibirsk, Russia

Ермаков Н. Б. Подразделения темнохвойных лесов северной Евразии для карты циркумбореальной растительности

The dark coniferous forests of Eastern Europe and Northern Asia show disjunctive ranges. They are dominated by four main conifer species: *Picea abies*, *P. obovata*, *P. jezoensis*, *Abies sibirica* and *Pinus sibirica*. Generalization of the regional systems gives us an important knowledge on syntaxonomic status and plant-geographical peculiarities of the high-rank dark coniferous forests. At present, two orders, *Piceetalia excelsae* and *Abieti nephrolepidis–Piceetalia jezoensis* represent “western” and “eastern” geographical subdivisions of these forests. However plant-geographic analyses demonstrated the need to differentiate the *Abieti-Piceetalia* into “boreal” and “hemi-boreal” vegetation types. East Asian hemi-boreal alliances of the *Abieti-Piceetalia* should be included in the temperate higher syntaxa. Typical boreal East Asian dark-coniferous forests should be included in the Eurasian order – *Piceetalia excelsae*. The basis of this solution is a distinct floristic core of dark coniferous forests which is stable through the whole their range from the Atlantic to Pacific. These are mesic, moderately cold-resistant and shade-tolerant species of Eurasian and Eurasian-North American range: *Athyrium filix-femina* s.l., *Dryopteris expansa* s.l., *Phegopteris connectilis*, *Diplazium sibiricum*, *Gymnocarpium dryopteris*, *Lycopodium annotinum*, *Oxalis acetosella*, *Sorbus sibirica*, *Maianthemum bifolium*, *Vaccinium myrtillus*, *Rhytidiadelphus triquetrus*. Alliances demonstrate biogeographical differentiation of dark-coniferous forests:

- *Piceion excelsae* Pawl. et al. 1928 – southern-boreal forests of the main part of Europe;
- *Aconito rubicundi–Abietion sibiricae* Anenkhonov & Chytry 1998 – southern-boreal forests of Eastern part of Eastern Europe, Urals, Western and southern Siberia;
- *Pino–Abietion sibiricae* Ermakov & Makhatkov 2011 all. prov. – northern-boreal forests of Siberia;
- *Pino pumilae–Piceion jezoensis* Krestov & Nakamura 2002 – southern and middle-boreal forests of Kamchatka;
- *Piceion jezoensis* Suzuki-Tokio 1973 – south boreal forest of Sakhalin and Hokkaido;
- *Abieti–Piceion jezoensis* Song 1991 – south boreal forests of continental part of Far East.

Screening of allelopathic invasive plants in Japan and East Asia

Yoshiharu FUJII

Tokyo University of Agriculture and Technology, Tokyo, Japan

Фудзии Ё. Мониторинг инвазионных растений с выраженными свойствами аллелопатии в Японии и Восточной Азии

Exotic plants threaten the integrity of agricultural and natural systems throughout the world. Many invasive species are not usually dominant in their native regions, but once they invaded into new regions, they competitively suppress the growth of their new neighbors. Callaway and his colleague published many papers demonstrating the importance of allelopathy of dominating invasive alien plants in North America and coined "Novel weapons hypothesis" (Science 2000). We have developed specific bioassay systems for allelopathy, named "Sandwich Method", "Plant Box Method", and "Dish-pack Method". By using these methods, we have done screening in Japan and surrounding countries and found some of the invasive plants are allelopathic. Some of allelochemicals were isolated. Among these plants, several examples of allelochemicals from alien plants in Japan will be demonstrated:

1) *Leucaena leucocephala*: an invader to tropical and subtropical island has an unusual amino acid, mimosine, isolated as the major allelochemical in this leguminous tree;

2) *Bischofia javanica*: native to south east Asia, but now becoming an invader in Ogasawara Island, has tartaric acid as allelochemicals;

3) *Prosopis juliflora*: leaching of the allelopathic substance, L-tryptophan from the foliage of this mesquite was demonstrated. Juliflorine, a unique alkaloid, was also detected as major allelochemical;

4) Other invasive alien plants with potent allelopathic activity are: *Coccinia grandis*, *Rottboellia cochinchinensis*, *Fumaria capreolata*, *Phalaris brachystachys*, *Physalis angulata*, *Gypsophila paniculata*, *Oenothera hookeri*, *Trifolium incarnatum*, *Ipomopsis rubra*, *Silene armeria*, *Avena strigosa* and, *Anisantha madritensis*.

Estimation of their invasion and toxicity to the environment, and the potential allelochemicals will be discussed. We would like to have cooperative research on the screening of allelopathic plants from East Asian Flora.

Specificity of lichen composition in temperate oak forest in Asian Pacific

Irina A. GALANINA

Botanical Garden-Institute FEB RAS, Vladivostok, Russia

Галанина И. А. Особенности состава лишайников в умеренных дубовых лесах тихоокеанской Азии

A study of lichen biota in temperate oak forest in Asian Pacific showed its specificity. There is a “core” of lichen species, characteristic of pure and mixed oak forests. This lichen biota is nemoral (144 species; 69 %) with prevalence of multiregional species (82; 39 %), Eurasian-American (45; 22 %) and East Asian (36; 17 %). Lichen biota of oaks also include species, characteristic of coniferous and mixed forests of the Sikhote-Alin Range. Taxonomic diversity totals 208 species of 63 genera and 26 families. Among them, 199 species are registered on the *Quercus mongolica* bark; and 88 species on the *Quercus dentata* bark. There are 78 lichen species common to both oak species. Dominance of species from the order Lecanorales is considered a characteristic feature of Holarctic floras. There have been studies of epiphytic lichens on *Quercus dentata* as well. In comparison with those met on *Quercus mongolica*, they have the following features: poor taxonomical diversity, weaker diversity of lichen communities, lesser frequency of crustaceous and fruticose growth forms, different leading taxa, prevalence of nemoral and East Asian elements. The taxonomic and geographical analyses of the specific structure of lichens on *Q. mongolica* and *Q. dentata* helped to identify a gradient between lichen biota of Korean and Sikhote-Alin origin. In the southern Khasan District, Primorsky Krai, “the cores” of characteristic species for both oak species have much in common (species composition, their frequency, projective cover); that proves long age of interactions between these two oak species in the landscape of the southern Primorsky Territory. Lichen biota on *Q. dentata* here are more specific in comparison with that of the Lazo District. In the foothills of Sikhote-Alin Range, “the core” of characteristic lichen species for both oak species essentially differs. In general, lichen biota appearance in the coastal broadleaved forests is formed by nemoral lichen species, which are mostly widespread in the one of broadleaved and coniferous-broadleaved forests.

The role of the Council of Botanic Gardens of Russia in the conservation of national flora

Yuri N. GORBUNOV & Alexander S. DEMIDOV

Tsitsin Main Botanical Garden RAS, Moscow, Russia

Горбунов Ю. Н., Демидов А. С. Роль Совета ботанических садов России в сохранении национальной флоры

There are 100 botanic gardens in Russia and their work on the conservation of flora is coordinated by the Council of Botanic Gardens of Russia (CBGR). “Russian Botanic Gardens Conservation Strategy” and “Methodical recommendations on reintroduction of plants” were prepared and published. An inventory of rare plant species conserved *ex situ* was made in 2003-2005 and in 2008-2009. About a third of Russian flora and 64 % of Red Data Book species are kept in living collections and meristem banks of Botanical Gardens. Thirty four species classified in category 1 (E) are cultivated, making 48 % from the general number of species of this category. Another 20 species are represented in collections of three and more botanic gardens (i.e. they have sufficient numbers in cultivation to provide an insurance for the future). A comparative analysis of two databases developed by the CBGR in 1988 and in 2008 was carried out. Results of the analysis show that for the period between 1988 and 2008 there has been an increase in the number of the botanic gardens in Russia maintaining collections of rare species, as well as a marked increase in the overall number of conserved species and samples. A report on Plants of Russian Red Data Book in collections of Botanic Gardens and Arboreta was published. Different projects on reintroduction of rare species are being carried out. Russian Botanic Gardens contributed significantly to achieving the aims of Global Strategy for Plant Conservation. They took an active part in study of regional floras (“Flora of East Europe”, “Flora of Siberia”, “Check list of Siberian flora”, “Vascular plants of the Soviet Far East”), identification of the key botanical areas, and preparation of a new “Red Data Book of Russia”. Specialists of Botanical Gardens conceived and prepared for publication a range of regional Red Data Books of: the Altai Republic, Altai Krai, Murmansk, Moscow, Tver, Rostov, Volgograd, Sakhalin and other territories. Methods of *ex situ* conservation of rare species were improved; education programs in the field of conservation of biodiversity of plants were developed.

East Asian plants in eastern US forests: are invaders pre-adapted for more efficient resource use?

Jacob Mason HEBERLING & Jason FRIDLEY

Syracuse University, Syracuse, New York, USA

Хеберлинг Я. М., Фридли Дж. Восточноазиатские растения в лесах востока Соединенных Штатов: приспособлены ли инвазионные виды к более эффективному использованию ресурсов?

The globalization of human activities has resulted in the widespread movement of plants around the world. Paradoxically, many of these exotic species are out-competing native plants, despite the presumption that native species have locally adapted to their environments. Further, global invasion patterns are frequently asymmetric, with some regions more likely to produce invasive species and others more likely to be invaded. This phenomenon is particularly prominent in eastern North American (ENA) forests, where an unexpected, substantial fraction of woody invaders originated from East Asia (EAS). Although both regions lie primarily in the north temperate mesic forest biome with comparable niches, EAS has much greater phylogenetic and species diversity than ENA. Historically, diversity differences may have led to greater competition and intense selection for more efficient resource-use strategies in the EAS flora. This bias could provide a mechanistic explanation for modern invasion patterns between the floristic regions. We used a large database of leaf physiological traits (including photosynthetic rate, leaf lifespan, leaf mass per area, and leaf nitrogen) and species native distribution data to test for large-scale functional differences among biogeographic regions. With some exceptions, the EAS flora exhibited a generally more efficient carbon economy than ENA plants. This general finding was supported in a common garden study that compared the leaf physiologies of congeneric ENA native and EAS invasive shrubs and lianas. These included 31 species representing 6 plant families from 8 genera, including *Lonicera*, *Euonymus*, *Berberis*, *Celastrus*, and *Rhamnus*. On average, introduced EAS species invasive in ENA forests had similar leaf metabolic costs, but had greater photosynthetic returns than ENA natives. Efficiency differences were further magnified through time when considering leaf lifespan. Overall, these findings suggest important region-level functional differences between ENA and EAS floras and could have implications for understanding modern patterns of floristic interchange and community re-assembly through plant invasions.

***Ex situ* cultivated flora of China**

Hongwen HUANG

South China Botanical Garden CAS, Guangzhou, China

Хуанг Х. Культивируемая *ex situ* флора Китая

With approximately 33 000 higher plant species, half of which are endemic, China ranks as one of the top countries in the world as a centre of floristic significance. This tremendous plant diversity encompasses a huge number of species of bryophytes (c. 2 200 species), pteridophytes (c. 2 600 species), gymnosperms (c. 250 species), and angiosperms (over 30 000 species) that occur in China, accounting for 9.1 %, 22 %, 26.7 % and 10 % of the world total, respectively. The Chinese flora constitutes the living remnants of the early Miocene floras of the whole North Temperate regions and is the sources of numerous crops and of medicinal and horticultural plants. Furthermore, a long history of agricultural civilization and crop plant domestication in China has generated an enormous variety of cultivated germplasm of crops, vegetables, fruits and ornamentals. However, the plant diversity in China is increasingly vulnerable, with an estimated 4 000 to 5 000 plant species threatened or on the verge of extinction, thus attracting one of the highest priorities for global biodiversity conservation. Coming in the face of the current ecological crisis, China has increasingly recognized the importance of plant diversity to the country's efforts to conserve and sustainably use plant diversity. Botanical garden conserved flora is quite extensive. A recent survey shows that the Chinese botanical gardens have maintained living collections of 23 340 species belonging to 3 633 genera, and 396 families in *ex situ* conservation. This presentation provides a comprehensive introduction to a long term plan of a recent initiative of 'Ex situ Cultivated Flora of China', aiming three main goals: 1) Enhancement of taxonomic research with common-garden based living specimens. The morphological and biological data collecting from common garden should provide both adequate and accurate description and delimitation of difficult taxa when traditional taxonomy revision were made based on herbarium specimens; 2) Support of comparative biology and frontier plant science research, such as: with increasing awareness of environmental and habitat changes in the overall background of climate changes on plant distributions in situ, the 'Ex situ Cultivated Flora' project should provide intensive plant biological information from different gardens across a wide spectrum of different latitudes, regional climates and habitats to related research on species adaptive evolution, plant migration and distribution shift and physiological or/and biochemical changes, etc.; 3) Strengthening germplasm discovery and sustainability of plant resources should enhance our current progress with medicinal plants, industrial bio-energy plants, landscaping and ornamental plants, new functional fruits and vegetables, environmental meliorating plants, etc. The project of 'Ex situ Cultivated Flora' is expected to be an important initiative of plant diversity research for sustainable economic and social development in China.

The vegetation of the *Machilus-Castanopsis* forest zone in Taiwan

Tzung-Tai HUNG¹, Tze-Ying CHEN¹, Chiou-Feng YU² & Ching-Feng LI³

¹ National Yilan University, Yilan, Taiwan

² Council of Agriculture, Executive Yuan, Taipei, Taiwan

³ Masaryk University, Brno, Czech Republic

Хунг Т.-Т., Чен Т.-Й., Ю Ч.-Ф., Ли Ч.-Ф. Растительность лесной зоны *Machilus-Castanopsis* Тайваня

The *Machilus-Castanopsis* forest zone is the major zone of evergreen forest in Taiwan. This study used detrended correspondence analysis (DCA) and cluster analysis to process the data of 2 286 plots from the Taiwan Vegetation Database. The result of the classification was a synoptic list based on the frequency values of species from various vegetation types. The characteristic species was then determined by the fidelity of species from various vegetation types. All processes are carried out by the two-step method. Based on the Braun-Blanquet system of floristic-sociological classification, similar vegetation types were combined into higher classes by their diagnostic species. DCA found a significant correlation between topography and winter precipitation. The vegetation classification of *Machilus-Castanopsis* forest zone consists of 47 sub-associations. These subassociation can be grouped into 18 associations, characterized respectively by *Cyclobalanopsis championii*, *Castanopsis fabri*, *Dysoxylum hongkongense-Drypetion karapinensis*, *Cyclobalanopsis hypophaea-Keteleerion formosanae*, *Amentotaxion formosanae*, *Castanopsis indica-Litsea akoensis*, *Symplocos congestae-Castanopsis carlesii*, *Ormosia formosanae*, *Calocedron formosanae*, *Rhododendron formosanum*, *Myrsine seguinii-Machilion thunbergii*, *Castanopsis sessilis*, *Castanopsis sessilis-Keteleerion formosanae*, *Turpinia ternatae-Castanopsis carlesii*, *Cyclobalanopsis longinus-Litsea acuminatae*, *Ficus irisanae-Machilion kusanoi*, *Phoebe formosanae-Litsea acuminatae* and *Glycosmium citrifoliae-Dendrocnidion meyeniana*. The associations can be grouped into 8 suballiances including *Schimenion kankaoensis*, *Neolitsenion parvigemmae*, *Ormosienion formosanae*, *Castanopsienion sessilis*, *Turpinienion ternatae*, *Ficenion irisanae*, *Litsenion acuminatae* and *Dendrocnidenion meyeniana*. These 8 suballiances can be combined into 3 alliances comprising *Litsea acutivenae*, *Diospyrion morrisiana* and *Machilion kusanoi*.

The biomorphology of the species of the genus *Trifolium* L. in the Russian Far East

Valentina A. KALINKINA

Botanical Garden-Institute FEB RAS, Vladivostok, Russia

Калинкина В. А. Биоморфология видов рода *Trifolium* L. на российском Дальнем Востоке

The range of many species in the genus *Trifolium* has expanded as a result of their use as agricultural crops. Within the territory of the Russian Far East there are 15 species of the genus *Trifolium*, of which 11 are exotic and only 4 are native. Species are morphologically herbaceous mono- or polycarpic, and are differentiated on the basis of above- and belowground parts. In the aboveground parts of Far Eastern species of the genus we have identified two types of shoots: extended (*T. arvense*) and semi-rosette (*T. pratense*, *T. repens*). Structural and biomorphological analysis of the belowground parts showed that there are species (*T. lupinaster*, *T. pacificum*, *T. gordejevii*), characterized by a high degree of multiplicity and ability to adapt to changing environmental conditions. Due to fluctuations in environmental parameters of habitat (moisture content, soil structure) species with taproots after the transition to adult vegetative or generative age states convert to fibrillose root or rhizomatous structure. Multiplicity is primarily typical for perennial species of the genus in question, but there are a number of annual clovers, which are also capable of changing their biomorphological structure. These species include *T. compestre*, the direction of the shoot growth of which depends on the light conditions in its habitat. Using multivariate classification as proposed by Zhukova (2012), we identified 3 types and 2 subtypes and a multiplicity of life forms of species of the genus *Trifolium* in the Russian Far East: structural (morphological, size-related), reproductive, and environmental. There are also species, the life form of which does not change. Such species we characterize as monomorphic.

Mountains of Kilpisjarvi as a refuge area for threatened plants in Finnish Lapland

Heikki KAUFANEN

Finnish Forest Research Institute, Kolari, Finland

Кауханен Х. Горы Килписъярви как рефугиум редких видов в Финской Лапландии

The botanically most famous mountains in Finland, Saana and Malla, are located by Lake Kilpisjarvi in north-westernmost Finland. This is the only area where Scandinavian Caledonian Range reaches into the Finnish area. The Kilpisjarvi area belongs to the subalpine vegetation zone. The lower mountain slopes are dominated by birch forests, whereas the treeless alpine vegetation prevail on the upper slopes. The bedrock consists partly of dolomitic rocks resulting in fertile *Dryas* heaths. Outcrops of dolomite rock on steep slopes and the basic soil below host a large number of rare species of several organism groups. Altogether 434 vascular plant species are found in Kilpisjarvi region. The most characteristic elements of the flora are the calcicolous alpine species, that are rare or absent in other parts of Finland. Altogether 29 species occur in Kilpisjarvi area only. One of the rarest species among them is *Oxytropis lapponica*, which is also rare throughout Scandinavia, the only population of which is on the slope of Mt. Pikku-Malla in Finland. Altogether 22 threatened and 19 near-threatened vascular plant species belong to the flora of Saana and Malla. Numerous rare and threatened species are also among the lichens and bryophytes of Kilpisjarvi area although these groups are less studied than vascular plants. As a result of an inventory in 2010, Finnish Forest and Park Service found in Malla Strict Nature Reserve six moss species, which are in need of special protection. One of them was *Orthothecium lapponicum* with only three occurrences in Finland, two of which are in Malla SNR. In 2007, a Finnish lichenologist Juha Pykala, found on Mt. Malla and Mt. Saana 20 lichen species which were new to Finland, six of them were also new to Fennoscandia. It is evident that these mountains are among the most valuable sites in Finland not only for vascular plants but for bryophytes and lichens as well.

Classification of species in the genus *Trapa* by morphometric fruiting features

Dmitry E. KISLOV, Ekaterina N. BERESTENKO

Botanical Garden-Institute FEB RAS, Vladivostok, Russia

Кислов Д. Е., Берестенко Е. Н. Классификация видов рода *Trapa* по морфометрическим признакам плодов

The paper discusses new approaches for solving the taxonomic problem of *Trapa* species, that occur in the territory of Primorsky krai (Russian Far East). At the present time, the problem of classification of *Trapa* species is still open, mostly, because of high variability of its morphological features. Therefore, deriving significant methods of discriminating between a specific set of objects is very difficult. It is generally accepted that *Trapa* fruit morphological features are used for *Trapa* species discrimination. In this work, attempts for improving existing classification schemes of *Trapa* species are based on two positions. First of these: to classify properly, one has to use most informative morphometric features of fruits, controlling feature extraction process by some cross-validation technique. The second is to follow treatments that are statistically valid. As a result of our research, we built a classification system of *Trapa* species. The system uses up to 27 morphometric features of *Trapa* fruits belonging to 8 species growing at the territory of Primorsky krai. Computations are based on classical and modern pattern recognition techniques (linear classification, knn-classification, consensus clustering, analysis of variance) and implemented in Python. It is shown, that *Trapa* species could be determined by its common morphometric features with high accuracy. For instance, misclassification errors for linear classification algorithm computed by leave-one-out cross-validation method are the following: *T. incisa* – 1.3 %, *T. nedoluzhkoii* – 0 %, *T. maximowiczii* – 2.5 %. The server of the classification system is built over the Django Web Framework and includes additional Python modules contributed by authors of the work. As generalization of features extraction procedure, a hierarchical classification tree was formed. It is presented as ensemble of nested dichotomies leading to specific *Trapa* species.

Pollen and seed surface morphology in some representatives of the genus *Rhododendron* L. in the Russian Far East

Inna M. KOKSHEEVA¹ & Natalia N. NARYSHKINA²

¹ Botanical Garden-Institute FEB RAS, Vladivostok, Russia

² Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

Кокшеева И. М., Нарышкина Н. А. Морфология пыльцы и семян некоторых представителей рода *Rhododendron* L. на российском Дальнем Востоке

We present a comparative study of pollen and seed morphology of three species of the genus *Rhododendron* L. subsection *Rhodorastrum* (Maxim.) Cullen. occurring in the Russian Far East (*Rh. dauricum* L., *Rh. mucronolatum* Turcz., *Rh. sichotense* Pojark.) using scanning electron microscopy (SEM). *Rh. sichotense* Pojark. was examined for the first time. Statistical analysis of data revealed that, based on a set of morphometric traits of pollen and seeds the species are different from each other. The sculpture of the seed surface was uniform mesh (reticular), but the morphometric study of seeds allowed allocating an additional diagnostic feature – the coefficient of elongation of cells. Pollen grains of *Rhododendron* L. are firmly united in tetrahedral tetrads, the shape of which is orbicular triangular and abjoining tightly, radially symmetrical, suboblate, monad grains are spheroidal, tricolporate. Electron-microscopic studying of pollen of the species showed that one of specific feature is the type of apocolpial exine sculpture and around the aperture. Identified morphometric characteristics of seeds and pollen contained in the species also in culture, proves the stability of the selected features. The study was supported by the Russian Academy of Sciences and Far East Branch, Russian Academy of Sciences (project no. 12-I-П28-01).

Combination of red list of East Asian countries/regions and comparison of threatened seed plants between Japan and its adjacent regions

Goro KOKUBUGATA & Masahiro KATO

National Museum of Nature and Science, Tsukuba, Japan

Кокубугата Г., Като М. Формирование списка редких растений стран и регионов Восточной Азии и сравнение угрожаемых семенных растений между Японией и прилегающими регионами

A red list has been independently published in each country/region. These red lists are valuable for understanding threatened species in these national and regional areas. On the other hand, global studies and investigations are essential for understanding the biology of threatened species, because national and regional borders are not respected by wild animals and plants. At the last EABGN meeting at Nagoya in 2010, the authors agreed to construct and promote a combined red list of East Asian countries/regions as useful material for discussion and collaborative research on threatened plants in East Asia. Herein, we present the combined red list consisting of threatened seed plants of China, Japan, South Korea, East Russia and Taiwan. Also we numerically compare threatened seed plants between Japan and the four adjacent regions. The number of threatened seed plant taxa (excepting Least Concern and Data Deficient) was 3 824 taxa for China, 1 775 taxa for Japan, 336 taxa for South Korea, 1 056 for East Russia and 1 141 taxa for Taiwan. Orchidaceae are the most threatened taxa in China, Japan, South Korea and Taiwan and Compositae – in East Russia. Out of the five regions, China has the largest number of threatened taxa; while Taiwan has the highest density of threatened taxa. Japan and each of the four countries/regions (China, South Korea, East Russia and Taiwan) share 92 (5.2 % of Japanese threatened taxa), 85 (4.8 %), 72 (4.1 %) and 108 (6.1 %) identical threatened plant taxa. These data indicate that generally the threat to plants is regional. The combined red list of East Asia totals 7 599 taxa (213 families), in which Orchidaceae (1 385 taxa; 18.2 %) are the largest. For further understanding the biology of threatened plants in East Asia, we should: 1) promote global taxonomic studies; and 2) standard categories and criteria under a uniform concept.

The main factors controlling florogenesis on rocky outcrops in southern Primorye

Marina N. KOLDAEVA

Botanical Garden-Institute FEB RAS, Vladivostok, Russia

Колдаева М. Н. Основные факторы, контролирующие флорогенез на скальных выходах южного Приморья

The flora of rocky outcrops of the southern Primorye is the richest in the Russian Far East. The reasons are the variety of landscapes and rock formations, the location of the territory in the area of the passage of important botanical and geographical boundaries and historical events. Rock outcrops in southern Primorye revealed 573 species of higher vascular plants that contain 228 species of rock flora proper. Analysis of areas shows that the rock flora of southern Primorye is mainly autochthonous within the East Asian floristic region. A feature of the rocky flora in the southern of Primorsky krai is a small fraction of species, that are narrowly adapted to growth on the rocky outcrops. The composition of the rock vegetation, as an azonal type within the forest zone, is formed primarily from elements of the zonal vegetation types (nemoral coniferous-deciduous and deciduous forests, forest-steppe and steppe), and some elements of azonal vegetation of the upper mountain zone. Many of these rocky outcrops act as refugia and many species south of Primorye are on the boundary of their distribution and are part of the border and islands areas. Based on the distribution of such locally common species we identified three vectors of the influence of various floras that contribute to the rocky flora in the south of Primorsky Krai. Major changes in the climatic conditions that occurred during the historical periods in the seashore areas of East Asia, including southern Primorye are reflected in the peculiarities of certain flora of rocky outcrops. In general, we consider the regularities of formation of the rocky flora in south of Primorye to be connected with the seashore area and select the model of florogenesis with the same name.

Wind hole as phytogeographical vault

Woo-Seok KONG, Sle-Gee LEE, Kwang-Hee YOON, Hee-Na PARK

Department of Geography, Kyung Hee University Seoul Republic of Korea

Конг В.-С., Ли С.-Г., Юн К.-Х., Пак Х.-Н. Ветровая труба как фитогеографическое хранилище

The presence of large number of cryophilous or cold-tolerant Arctic-Alpine Plant (A-AP) and Alpine Plant (AP) in at heterogeneous habitats, such as alpine belts, islands, and other specific locations such as peninsulas is of considerable biogeographically interest. Occurrence of A-AP floristic elements at unglaciated lowland wind hole or air hole, where the ground air layer is cooler in summer, but milder in winter than an overlying layer, is of interest with respect to phytogeography. Disjunctive distribution of *Vaccinium vitis-idaea* or mountain cranberry at lowland wind hole needs scientific explanation in connection with both past and present environments. People also need to know what could happen if the current global warming trend exceeds the physiological adaptation and migration speed of A-AP and AP. *V. vitis-idaea*, which is common on the circumpolar regions and alpine belts of the Northern Hemisphere, also occurs on the alpine and subalpine belts of the Korean Peninsula, including Mt. Sorak (128°27'55"E, 38°07'08"N) and Hongcheon (128°16'15"E, 37°48'28"N) in R.O.K. *V. vitis-idaea* at the elevation of c. 350 m a.s.l. of Hongcheon wind hole (200 m²), is regarded as one of its global southernmost distributional limits. As such it might have provided a habitat as a glacial relict of the Pleistocene period, and at present shows a disjunctive distribution (56 km distance away) since the Holocene period. The presence of *V. vitis-idaea* at the Hongcheon refugium might imply the existence of previous floristic linkage among these populations as a glacial relict. Present vertical range differences of *V. vitis-idaea* between Mt. Sorak and Hongcheon might indicates that the temperatures during glacial epoch was colder than today, down to -6 to -7°C. A major restriction factor for the present distribution of cold-loving *V. vitis-idaea* seems related to the summer maximum temperature, and its presence at this fragile wind hole site could be endanger if current global warming trends continues, and anthropogenic activities become serious aggravated. This study is supported by the 2010 project by Korea National Arboretum.

***Milium effusum* L. (Poaceae) in East Asia differs strongly in ITS sequence from conspecific plants in other parts of the species range**

Violetta V. KOTSERUBA¹, Victoria S. SHNEYER¹, Nina S. PROBATOVA²,
Andreas HOUBEN³ & Frank R. BLATTNER³

¹ Komarov Botanical Institute RAS, Saint-Petersburg, Russia

² Institute of Biology and Soil Science, Vladivostok, Russia

³ Leibniz Institute of Plant Genetics and Crop Research, Gatersleben, Germany

Коцербу В. В., Шнеер В. С., Пробатова Н. С., Хубен А., Блаттнер Ф. Р. Восточноазиатский *Milium effusum* L. (Poaceae) отличается от растений этого вида из других частей ареала по ITS последовательности

Milium effusum L. (Poaceae, Poaeae) is a perennial widespread woodland species distributed across Europa, Asia, in the northeastern parts of North America throughout much of the Holarctic ecozone with disjunction in the west of North America. Tetraploid ($2n = 28$) chromosome number was constant in all the samples investigated. Plants from different parts of the range are morphologically uniform. Allozyme variation analyses found the species to be variable but no clear geographic patterns in the distribution of alleles were found among samples from Europe and the Altai Mountains (Tyler, 2002). The nuclear ribosomal DNA internal transcribed spacer region (ITS) was found to be informative in the phylogenetic studies at the species and intraspecies level. We investigated the region ITS1-5.8S-ITS2 in 4 species of *Milium*. *Milium effusum* was represented by samples from throughout most of its distribution range – from different regions of Europe, Caucasus, Siberia, Middle Asia, Eastern Asia, and North America. All sequences formed two distinct clades with the samples of *M. effusum* from Eastern Asia (Kamchatka, Kuril Islands, Primorsky krai, Japan, China) clustering into a separate clade than the rest of *M. effusum* samples which formed the second clade together with *M. transcaasicum* and *M. schmidtianum* (all from the section *Milium*). The pairwise sequence divergence between two clades is 0.054. It is close to that between *M. effusum* and *M. vernale*, the species from the other section of the genus (0.060). Further research should be done to elucidate if plants from East Asia represent a separate taxon, subspecies or even cryptic species. The research was supported by DAAD, DFG and RFBR grants.

Alien plants in the natural flora of Primorsky Territory

Andrey E. KOZHEVNIKOV & Zoya V. KOZHEVNIKOVA

Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

Кожевников А. Е., Кожевникова З. В. Заносные виды в естественной флоре Приморья

The complex of alien species in flora of the Russian Far East includes 743 species of vascular plants, 621 (83.6 %) of which are represented in flora of Primorsky Territory, i.e. 23.1 % of natural flora of this area. The total group of naturalized plants (NP) in Primorsky Territory includes 457 species (73.6 %), among them agriophytes (transformes) – 24 species (3.9 %), epikophytes (invasive plants) – 206 (33.2 %) and kolonophytes (naturalized plants) – 227 (36.6 %). The group of ephemerophytes (casual alien plants) covers 164 species (26.4 %). Alien species of the Primorsky Territory can be divided into several groups by the character of geographical distribution. The most numerous group (I) with Eurasian-Mediterranean type of distribution includes 219 species, 83.7 % of which are naturalized. The group of American plants (II) consists of 104 species (NP 69.6 %), 59 species of which are North American ones. The group of Asian plants (III) covers 103 species (NP 55.9 %), in that number Pan Asian – 38 (NP 60.5 %), East Asian – 21 (NP 85.7 %), Central Asian – 13 (NP 50 %), West Asian – 11 (NP 45.5 %), South Asian – 7 (NP 14.3 %) and North Asian – 3 (NP 100 %). There are other less numerous groups: Eurasian group (IV) includes 72 species (NP 61.1 %), Mediterranean (V) – 46 (NP 52.3 %), Circumpolar (VI) – 24 (NP 87.5 %), European (VII) – 16 (NP 81.3 %), Tropical (VIII) – 9 (44.4 %) and African (IX) – 6 (NP 0 %), as well as Australian – 1, North African–Middle Asian – 1, European–North American – 1 and Unidentified – 2. At the same time, 25 species, for which Primorsky Territory is the territory of secondary (anthropogenic) extension of the area, are represented here. In summary, we can include into the number of alien species component in flora of Primorsky Territory 646 species, that representing 24 % of natural flora of this territory.

Mapping boreal vegetation in conditions of disturbance regime: a case from the southern boreal subzone in the Russian Far East

Pavel V. KRESTOV^{1,2}

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

² *Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia*

Крестов П. В. Картографирование бореальной растительности в условиях нарушений на примере южно-бореальной подзоны российского Дальнего Востока

A prototype vegetation map of the eastern Asian sector of circumboreal zone was prepared to represent of a portion the middle and southern subzone of boreal zone that included a gradient of regional climates from subcontinental to suboceanic. The vegetation pattern of the area is complicated because it 1) occurs along a gradual transitional zone between typical temperate and boreal macrobioclimates; 2) has had a long historical period of fire and logging; and 3) is represented by two principal boreal vegetation types – larch and spruce forests. Post-fire succession in the areas of spruce forests results in the formation of spruce stands, but various factors may hinder succession from the standard sequence. The unstable climate in combination with marginal permafrost and soil freezing regime is greatly compounded by a diversity of substrates that make the pattern post-fire forest succession more complicated. In the spruce forested area with low temperatures, fires have not only a direct effect on forests, but also change the soil freezing regime and may result in different post-fire succession sequences toward the formation of long-term larch forests. Because such forests are relatively permanent and occupy extensive areas, it is important to show them in a map of potential vegetation in the scale 1 : 7 500 000.

Distribution of vascular plants in Northeast Asia: climatic controls and historical background

Pavel V. KRESTOV^{1,2}

¹ Botanical Garden-Institute FEB RAS, Vladivostok, Russia

² Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

Крестов П.В. Распространение сосудистых растений в северо-восточной Азии: климатические факторы и история растительного покрова

The development of vegetation on the east of Asia is controlled by polar, boreal and temperate macrobioclimates. Basic variations of vegetation along the gradient of continentality within a zone depend on the combination of the yearly heat and precipitation distribution and can be classified into 7 climatic types: hyperoceanic, oceanic, suboceanic, maritime, continental, subcontinental and ultracontinental. In the boreal zone, the areas with the highest continentality values are occupied by the deciduous coniferous forests, and the areas with lowest continentality values – by broadleaved deciduous forests dominated by Ermann's birch. The ombro-evapotranspirational index calculated for vegetation orders shows that continental boreal forests of Asia occur in critical conditions of significant moisture deficit, which normally do not support forest vegetation. The most important source of water in dry areas of the boreal zone is melting permafrost. Climatic oceanicity results in formation of a specific vegetation complex composed of humidity-dependent and frost-intolerant species adapted to the short growing seasons. The strong accumulation of snow causes a 2-3 week delay of its melting and a considerable shortening of the growing season. Increasing longevity of deep snow cover leads to vegetation transformation from forests to tall herb meadows through the stage of alder krummholz. Fluctuating humidity and balancing of continentality–oceanicity were the major factors affecting the vegetation changes in the Holocene. At time of late Pleistocene aridification the climate favoured intensive migration of Central Asian steppic floristic elements which make up a significant component of the modern flora of south-western and eastern Siberia. Xeric and mesoxeric floral elements with a great number of neoendemics from the mountains of southern Siberia characterize the *Rhytidio-Laricetea*. Aridification in the temperate zone led to distinctive separation of insular and mainland vegetation complexes in Northern Asia with a retreat of thermophilous species especially on the mainland. The increase in temperatures and humidity caused a rapid expansion of larch forests over great areas up to the Arctic coast in the period 10000–5000 yrs BP and the formation of the *Ledo-Laricetalia* characterized by wetland vascular species and bryophytes with circumboreal distribution. Forest retreat at about 3500 yrs BP led to the formation of extensive thickets dominated by shrubby birches, willows and larch woodlands. One of the most important refugia for the humidity-dependent vegetation in the Pleistocene was the north-western coast of Pacific Ocean, which still supports many Tertiary relics. All zonal vegetation types of Northern Asia show strong floristic relationships to Beringia and northern Pacific Islands.

Botanic Gardens at the crossroads: the ecologically significant resources in the global system of social coordinates in 21st century

Victor Ya. KUZEVANOV

Botanic Garden of Irkutsk State University, Irkutsk, Russia

Кузеванов В. Я. Ботанические сады на перепутье: экологически значимые ресурсы в глобальной системе социальных координат в 21 веке

Today, many prominent russian scientists and decision makers agree that in the current situation the ecology is not just a science, but also, to a large extent, a vital security issue of the humankind. This work presents a comprehensive scientific analysis of the 300-year period of development of botanic gardens (BGs) in the East Asia and the world proving the idea that modern botanic gardens are a special type of socially oriented environmental agencies in urbanized areas. In this article, which is based on special studies and fundamental research, we have attempted to review how the role played by BGs in the society had been changing during the decades of socio-economic development; how their appearance had transformed from the monastery and "apothecary" gardens to the modern university and academic institutions and cross-disciplinary public complexes. In addition to their classical roles as documented collections for science, education, conservation and a display their new objectives go beyond the garden's fence. Due to their scientific, educational and plant resources, they can be regarded as a unique anti-crisis "tool" helping people from different layers of society to adjust to global environmental change and promoting the sustainable development of our civilization. BGs in countries and regions became important impact factors of tourist attractiveness and a regional competitiveness. A mission change of contemporary BGs and their transformation from just botanical and horticultural organizations of agricultural type into multifunctional socio-ecological objects and regional multi-utility is considered. The problems of the development of the innovative project of the ecological technopark and a public recreational complex based on the Irkutsk University Botanic Garden resources is described. The economic and institutional problems of the project development are analyzed in relation to a tourists attractiveness, an introduction of ecological innovations and a public-private partnership for the competitiveness of the regions.

Creation of the Japanese Garden as a new tool for university cooperation in the heart of Asia

Victor Ya. KUZEVANOV¹, Hajime MATSUSHIMA², Takuhiro YAMADA³
& Svetlana V. SIZYKH¹

¹ *Botanic Garden of Irkutsk State University, Irkutsk, Russia*

² *Research Faculty of Agriculture, Hokkaido University, Sapporo, Japan*

³ *Hanatoyo Landscape Co., Ltd., Kyoto, Japan*

Кузеванов В. Я., Мацусима Х., Ямада Т., Сизых С. В. Создание японского сада как новый инструмент университетского сотрудничества в сердце Азии

The purpose of this paper is to demonstrate the potential of mutually beneficial cooperation of Botanic Gardens in East Asia to strengthen their role and influence in urban areas through the implementation of international botanical, environmental and social projects. The article describes a history and challenges of creating of an authentic Japanese Garden in the Russian Botanic Garden of the Irkutsk State University, Irkutsk, Eastern Siberia, established by Japanese and Russian professors, gardeners and university students in the heart of Asia. The ethnobotanical Japanese Garden is a unique facility for interdisciplinary research and academic cooperation in field of botany, horticulture, ethnography, psychology, medicine, geography, linguistics, ecology and nature management, landscape design and architecture, public education, biodiversity conservation, nature protection, etc. It is shown that offsprings of the Japanese A-bomb trees (Green Legacy Hiroshima trees) that survived the nuclear explosion in Hiroshima can be a good supplement to the display of the Japanese garden and can be a powerful peace message to the local population and the world. Perspectives of other national type of traditional oriental gardens (Chinese, Korean, etc.) as cross-disciplinary tools for various departments and specialties of higher professional education at the universities in Siberia are discussed.

The traditional knowledge survey of forest plants in Gangwon province, Republic of Korea

Hyunseok LEE, Chanhoo AN & Jaeseon YI

Gangwon National University, Chuncheon, Republic of Korea

Ли Х., Ан Ч., Йи Дж. Обзор традиционных знаний лесных растений в провинции Кангвон, Республика Корея

Traditional knowledge is referred to here as the knowledge conveyed from the previous generation to the present one about using materials originating from plants or animals in food, medicine, household, goods, etc. We surveyed and documented traditional knowledge on mountain-grown plants through interviews of local people in Gangwon province, the Republic of Korea located in the mid-eastern part on Korean Peninsula. The province was divided into five survey areas, for the sake of convenience, along the Baedudaegan mountain range. It was found that men have more traditional knowledge than women. It is presumed that men usually work in the field and have more opportunities to harvest plants in mountain and field than women. Persons who are 71 to 75 years old knew more than persons of other ages. More than half of the plants surveyed were used as medicines to cure cold, fever, stomach ailments, joint pains, injury, woman's disease, etc. The secondary usage was for food. Some of the plants were used differently both in purpose and method by different communities. Medicinal and edible plants were important during the last decades because medicines and even food were not easily available due to colonization and internal conflicts. Some plants used have toxic materials, but interviewees knew well how to remove them, although the process was not supported scientifically and technologically. Thus it needs a lot of caution if one takes these plants as medicine or food. The most popular part of a plant is whole plant, leaves, roots, stem, in that order. It was believed that herbs are used more frequently than trees because they are easily accessible and not necessarily divided. The collection season was from spring to autumn, widely distributed throughout the year.

Global warming and vulnerability assessment of plant distribution in Korea

Sle-Gee LEE, Woo-Seok KONG, Hee-Na PARK

Kyung Hee University, Seoul, Korea

Ли С.-Г., Конг В.-С., Пак Х.-Н. Глобальное потепление и оценка уязвимости распространения растений в Корее

Due to the recent rapid global warming trend in Korea, the survival and migration of many plants in slow motion or in a hostile environment will be hindered in the future. Plants, which are vulnerable to global warming, include species with their distribution confined to alpine and subalpine belts, species with a narrow distribution, species at their range limit, species growing in small islands, species sensitive to climate change, and species with slow migration rates. With temperature rising, the cold-loving alpine plants of Korea, which belong to relict species of Last Glacial Maximum, are again forced to move upward or northward. Survival of high mountain plant species, however, will be resolved when two conditions are met; first, an availability of cool micro-climate at high mountain tops, secondly, accessibility and connectivity of mountain peaks which enable plants to migrate towards new habitats, thirdly, species need to be able to outcompete new contenders, and finally be able to overcome new environmental conditions. Projected distribution of cold-loving plant species in Korea with climatic amelioration rates, +0.3, 0.5, 0.9 and 1.2 degrees shows that many alpine plants, especially species at Hallasan (1 950 m a.s.l.), Jeju Island and Baekdoosan or Mt. Baekdoo (2 744 m a.s.l.) in D.P.R.K. or North Korea will be in danger at their current locations. This study is supported by the Korea National Arboretum.

Classification of Taiwan forest vegetation

Ching-Feng LI¹, Milan CHYTRÝ¹, David ZELENÝ¹, Tze-Ying CHEN²
& Chang-Fu HSIEH³

¹ Masaryk University, Brno, Czech Republic

² National Yilan University, Yilan, Taiwan

³ National Taiwan University, Taipei, Taiwan

Ли Ч.-Ф., Хитрый М., Зеленый Д., Чен Т.-Й., Хсие Ч.-Ф. Классификация лесной растительности Тайваня

We identify the main forest vegetation types in Taiwan, provide their formal definitions, and describe their species composition, habitat affinities and distribution in using 6 574 releves from the Taiwan Vegetation Database. Twelve vegetation types of zonal forests and nine types of azonal forests were distinguished. Zonal types in the subtropical region, from high mountains to foothills, are *Juniperus* subalpine coniferous woodland, *Abies-Tsuga* upper-montane coniferous forest, *Chamaecyparis* montane mixed cloud forest, *Fagus* montane deciduous broadleaved cloud forest, *Quercus* montane evergreen broad-leaved cloud forest, *Machilus-Castanopsis* submontane evergreen broad-leaved forest, *Phoebe-Machilus* submontane evergreen broad-leaved forest and *Ficus-Machilus* semi-evergreen foothill forest. Zonal types in the tropical region, from high mountains to foothills, are *Pasania-Elaeocarpus* montane evergreen broad-leaved cloud forest, *Drypetes-Helicia* submontane evergreen broad-leaved forest, *Dysoxylum-Machilus* foothill evergreen broad-leaved forest, and *Aglaia-Ficus* foothill evergreen broadleaved forest. Azonal types are *Illicium-Cyclobalanopsis* tropical winter monsoon forest, *Pyrenaria-Machilus* subtropical winter monsoon forest, *Diospyros-Champereia* tropical rock outcrop complex forest, *Zelkova-Quercus* subtropical rock outcrop complex forest, *Pinus* successional woodland, *Alnus* successional woodland, *Trema-Mallotus* successional woodland, *Scaevola-Hibiscus* seashore woodland, and *Kandelia* mangrove. Diversity of forest vegetation in Taiwan is strongly structured by the temperature and moisture gradient. Along the temperature gradient, five altitudinal zones can be recognized. Zonal vegetation contains a higher ratio of endemic and Pacific species and occurs in wetter habitats, while azonal vegetation contains coexisting species from different regions and usually occurs in drier habitats. The units of the resulting classification were formally defined by a Cocktail determination key, which can be used for automatic assignment of new vegetation plots to these vegetation types.

The classification of high-mountain coniferous forests vegetation in Taiwan

Cheng-Tao LIN¹, Ching-Feng LI², David ZELENÝ², Milan CHYTRÝ²
& Chyi-Rong CHIOU¹

¹ National Taiwan University, Taipei, Taiwan

² Masaryk University, Brno, Czech Republic

Лин Ч.-Т., Ли Ч.-Ф., Зеленый Д., Хитрый М., Чيوу Ч.-Р. Классификация высокогорной лесной растительности Тайваня

The coniferous forests over the boreal zone and mountainous areas of northern hemisphere were well studied in the past centuries, but studies of similar coniferous forests in subtropical high mountains are still have limited. The purpose of this study use a national phytosociological database to classify the high-mountain coniferous forests and then to discuss whether these vegetation units belong to *Vaccinio-Piceetea*. We used the relevés from the database of National Vegetation Diversity Inventory and Mapping Project to establish the vegetation units and characterise their distribution and environmental variables. Cluster analysis was used to classify vegetation units, while ordination analysis, such as principal component analysis, was also used to distinguish important environmental variables. An identification key based on classification tree was also developed to identify these vegetation units in the field. The results show that site aspect, elevation and soil rockiness and inclination were most important variables related to species composition. Two alliances and nine associations were established in the high-mountain regions from 2500–3800 m a.s.l. *Juniperion squamatae* represents the woodlands and forests dominated by *Juniperus squamata* in canopy layer with subalpine meadow species in understorey scattered in subalpine belt, while *Abieti kawakamii-Tsugion formosanae* represents the forests dominated by *Abies kawakamii* and *Tsuga chinensis* var. *formosana* in the canopy layer with shade-tolerant herb species in the upper montane belt.

Late Holocene development of vegetation cover of Putyatin Island (Peter the Great Bay, Sea of Japan)

Marina S. LYASHCHEVSKAYA, Ilona M. RODNIKOVA, Alena G. KISELEVA
& Nina F. PSHENICHNIKOVA

Pacific Geographical Institute FEB RAS, Vladivostok, Russia

Лящевская М. С., Родникова И. М., Киселева А. Г., Пшеничникова Н. Ф.
Развитие растительного покрова острова Путятин (залив Петра Великого, Японское море) в позднем голоцене

The island offers exceptional opportunities for investigating distribution and development of the local flora. The goal of this research is to analyze the current state of soil-vegetation cover and to reconstruct Putyatin Island palaeo-vegetation. Vascular plants and lichens were used as indicators of the current status of vegetation. In different types of landscapes soil profiles were laid. For reconstructing vegetation dynamics, soil samples were collected from genetic horizons of the soil profiles for spore-pollen analysis. The contemporary vegetation of the island comprises anthropogenically transformed forests, broad-leaved forests, shrubby associations, grassy associations of swamps, lakes and coasts. Broad-leaved forests are represented largely by *Quercus mongolica*, *Tilia amurensis*, *Ulmus japonica*, *Fraxinus rhynchophylla*, *Betula davurica*, *B. platyphylla*, *Acer mono*, *A. pseudosieboldianum*, *Phellodendron amurense*, *Carpinus cordata*, *Kalopanax septemlobus*. Most lichen communities consist of *Flavoparmelia caperata*, *Myelochroa aurulenta*, *Parmotrema reticulatum*, *Phaeophyscia hirtuosa* which are widely spread along the entire shore of Peter the Great Bay. In the Northern part of the island, lichen communities, which include rare lichen species *Cococarpia palmicola*, *Anzia colpodes*, *Pannaria lurida*, *Usnea rubicunda*, are found. The lichens show evidence of oppression in some places. The soil cover under the forest stand on Putyatin Island is represented by brown soils. The soil profile is shallow and highly skeletal. Spore-pollen analysis data give evidence of several stages of vegetation development in Putyatin Island in late Holocene; all stages are connected with general regional fluctuations of climate. The first stage witnesses wide distribution of wormwood-forb-shrubby associations and birch forests with coniferous and broadleaved species. The second stage represents development of coniferous-broadleaved forests. The third one that corresponds with present-day vegetation of the island is secondary in origin and results from anthropogenic influence. This study is supported by RFBR grants (12-05-00017, 12-05-00202) and FEB RAS Presidium grants (12-III-A-09-208, 12-III-B-09-200).

The moss flora of Olskoye Plateau (Magadan region)

Elena A. MALASHKINA¹ & Valentina Ya. CHERDANTSEVA²

¹ Botanical Garden-Institute FEB RAS, Vladivostok, Russia

² Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

Малашкина Е. А., Черданцева В. Я. Флора мхов Ольского плато (Магаданская область)

Olskoye Plateau is located in the southern part of the Kolyma Upland. It covers a range of elevations from 1100 to 1600 m. a.s.l., and is composed by tabular Tertiary basalts. The climate is moderate continental, the mean of January (coldest month) temperature is -32°C , the mean of August (warmest month) temperature is the $+11 - +12^{\circ}$, the mean annual temperature is -1.5° . The plateau is located in the permafrost zone and, due to poor drainage of basalt rocks, is characterized by extreme ground moisture in comparison with the adjacent landscapes. The plateau is covered by subalpine vegetation with *Larix* forests rising up to 1000-1100 m a.s.l. usually with an undergrowth of *Pinus pumila*. The alpine belt is occupied by different types of tundra: herb-moss, moss-dwarf-shrub, moss-lichen. The very diverse vascular plant flora of Olskoye Plateau is well studied compared with only a limited study of the mosses. During the present work, we have identified 135 species and 2 variations of mosses, belonging to 30 families and 66 genera. The distribution of many taxa was very clear. Five species and one variety (*Brachythecium jacuticum*, *Bryum longisetum*, *Dicranum bardunovii*, *Orthothecium rufescens*, *Sphagnum rubiginosum*, *Hylocomium splendens* var. *alaskanum*) were firstly recorded for the Northeast Asia. *Hygrohypnum cochlearifolium* and *Pohlia berengensis* were previously found in Chukotka and *Schistidium obscurum* only in Kamchatka Territory. Fifty-seven taxa (*Bryum creberrimum*, *Bryum pseudo-triquetrum*, *Fissidens bryoides*, *Polytrichum strictum*, *Warnstorfia fluitans*, etc.) were recorded for the first time for the Magadan Province. The leading families of floristic composition are Bryaceae (14 species), Sphagnaceae (12 species), Mniaceae (10 species). Geographically bryoflora of Olskoye Plateau is arctic, with a large number of hypoarctic (*Tomentypnum nitens*, *Meesia triquetra*, *Paludella squarrosa*, *Bartramia ithyphylla*, etc.), arctic (*Brachythecium udum*, *Cinclidium subrotundum*, etc.) and arctic-alpine species (*Philonotis tomentella*, *Aulacomnium turgidum*, *Racomitrium lanuginosum*, etc.).

Development of palynoflora throughout the Late Cretaceous and Paleocene in the Amur River region

Valentina S. MARKEVICH & Eugenia V. BUGDAEVA

Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

Маркевич, В. С., Бугдаева, Е. В. Развитие палинофлоры в период позднего мела – палеоцена в бассейне реки Амур

The Santonian palynoflora of the Zeya-Bureya Basin was dominated by cyatheaceous and dicksoniaceous ferns, and taxodialeans. Gymnosperms are mainly represented by *Ginkgocycadophytus* and the Pinaceae and Taxodiaceae; angiosperms – by Juglandaceae. In the Campanian palynoflora Cyatheaceae and Polypodiaceae prevail; among gymnosperms – conifers; angiosperms are represented by the Platanaceae, Fagaceae, and Juglandaceae. Triprojectate pollen is rare. The angiosperms are numerous in the early Maastrichtian palynoflora. The diversity of triprojectate pollen increases. Among gymnosperms, the Pinaceae and Taxodiaceae dominate. The middle Maastrichtian palynoflora is dominated by gymnosperms (Pinaceae, Taxodiaceae, and *Ginkgocycadophytus*); among angiosperms the Betulaceae, Juglandaceae, Fagaceae, Ulmaceae, and Myricaceae prevail. The late Maastrichtian palynoflora is dominated by the Taxodiaceae and Ulmaceae; among ferns the polypodiaceous spores are abundant; the angiosperms are rather diversified and are represented by pollen having affinity with the Betulaceae, Salicaceae, Juglandaceae, Myricaceae and Myrtaceae. The diversity of triprojectate pollen also increases. Floral changes were gradual across the boundary between the Mesozoic and Cenozoic eras. Only some Cretaceous palynotaxa disappear; the structure of dominance changes, but composition of the palynoflora mostly remains invariable. The early Danian palynoflora is dominated by ferns (Polypodiaceae) and gymnosperms (Taxodiaceae, Cupressaceae, and Pinaceae); and among angiosperms, the Juglandaceae and Fagaceae dominate. The triprojectate pollen is rare, and its taxonomical diversity decreases. This research was supported by the Russian Academy of Sciences (grant № 12-I-P28-01), Russian Foundation for Basic Research (grant 12-04-01335), Far East Branch of RAS (grant 12-III-A-06-075, 12-III-A-06-070).

Identifying rare communities and forests with heightened vegetative diversity in the Russian Far East

Brian MILAKOVSKY

WWF Russia, Amur Branch, Vladivostok, Russia

Милаковски, Б. Выявление редких сообществ и лесов с высоким растительным разнообразием на российском Дальнем Востоке

The Far Eastern region supports the highest levels of biodiversity in the Russian Federation. Widespread transformation and degradation of native ecosystems in this region necessitates the delineation and protection of ecosystems supporting rare species or exceptional biodiversity. But the large scale of the region and its incomplete scientific description it necessary to identify tendencies in the distribution of these communities that would expedite their delineation. One approach is the delineation of “intact forest landscapes”. Large, unaltered blocks of primary forests that include communities in various topographic positions can protect a broad range of native biodiversity. But this approach has some weaknesses – biodiversity-rich ecosystems that are fragmented or partially disturbed are excluded. Including other indicators besides “intactness” is necessary. In the Far East indicators such as the correlation between canopy tree diversity and understory diversity and the heightened value of the forest-alpine ecotone are being experimented with. Further study of tendencies in the distribution of rare plant species, rare plant communities and forests with heightened vegetative diversity is necessary.

The study of plant growth activity of seeds of invasive species *Heracleum sosnowskyi* Manden Umbeliferae

Maryia Yu. MISHYNA¹, Nikolai A. LAMAN², Valery N. PROKHOROV² & Yoshiharu FUJII¹

¹ Tokyo University of Agriculture and Technology, Tokyo, Japan

² Institute of Experimental Botany, Minsk, Belarus

Мишина М. Ю., Ламан Н. А., Прохоров В. Н., Фудзии Ё. Исследование роста и развития семян инвазионного вида *Heracleum sosnowskyi* Manden Umbeliferae

Heracleum sosnowskyi was introduced in the countries of eastern Europe where, due to favourable conditions for growth and development in the main areas of introduction invaded large areas, leading to the active exclusion of native species and thus reduced biological diversity. Annually on the territory of Belarus and neighboring countries the area of its population increases by ≥ 10 percent. One reason for the rapid expansion and high invasiveness of alien plant species is their allelopathic activity. In particular, at the stage of germination of seeds, allocating exometabolites create around themselves a biochemical and microbiological environment and in the early stages of ontogeny between them a phytocenotic relationship is established. Part of the research of allelopathic activity of *Heracleum sosnowskyi* is to study the influence of substances released by swelling of its mericarps, fruit cover and seeds on primary growth of *Vicia sativa* L. seedlings. Joint germination *Vicia sativa* cv. Natalie with swelling mericarps of *Heracleum sosnowskyi* resulted in a significant increase of the epicotyl length of seedlings – 2.7-22.8 % relative to control ($P = 0,0056$). Substances from the fruit cover significantly inhibited the primary growth of epicotyl (3.71 ± 0.38 cm) and roots (3.29 ± 0.25 cm) that were 30.9-52.6 % and 14.5-42.1 % compared with the control respectively. Also noted was a slight trend toward inhibition by *Heracleum sosnowskyi* seeds without fruit cover the growth of seedlings of *Vicia sativa*. The length of epicotyl was 3.5-9.2 % and the length of the roots – 4.9-19.6 % compared with control ($P = 0,0097$). Thus it was shown that the compounds of inhibitory nature in the seeds of *Heracleum sosnowskyi* mainly localize in the fruit cover. Probably the mechanism of action of these substances is due to inhibition of the processes of division and differentiation of cells in the early stages of ontogeny. These studies facilitate further study of *Heracleum sosnowskyi* allelopathic characteristics, as a factor of high invasiveness.

East Asian species in alien flora of European Russia

Olga V. MOROZOVA

Institute of Geography RAS, Moscow, Russia

Морозова О. В. Восточноазиатские виды в заносной флоре европейской России

Due to its geographical location, European Russia may be presented as a cross-road between West and East. There are about 1750 alien species reported from this territory that is considered one of the important portals for alien species of eastern origin to Europe. This study aims to examine European Russia's alien plant species originating from East Asia. These species make 14.5 % of species alien to whole territory of European Russia and about 5.5 % of the total number of alien species. These alien plant species, all of which are neophytic, were analyzed with regard to their floristic status, biological and ecological attributes. The proportion of East Asian alien plants in district floras ranges from 0.4 to 7.5 %. There are no species recorded from all districts; one quarter is found in more than 10 districts. Intentional introductions (70 % of the total number of aliens) prevail over unintentional (30 %); ornamental and horticultural introductions escaped from cultivation predominate. The invasive status of species changes according to geographical location of districts, and it is impossible to name their exact number. There are about 55 % casual, 30 % naturalized and 9.5 % invasive species (in the sense of Richardson et al. 2000) recorded from 48 of 52 administrative districts. Naturalized species are present in a half of the districts studied, and only four species of a total number of accidentals may be considered as naturalized. The pattern of distribution arises partly for scientific reasons (e.g. lack of alien species research, inaccuracy of data), but there are also climatic influences. Five of East Asian species are serious invaders in European Russia: *Rosa rugosa* – in the shore of Baltic Sea, *Reynoutria japonica* – in the North of Central Russia, *Sorbaria sorbifolia* – in Central Russia, *Ulmus pumila* and *Zizania latifolia* – in the southern districts of European Russia, two of these are invasive in many European countries.

Mosaic structure of mixed broadleaved forests in the Primorye region at the final stages of succession

Tatiana A. MOSKALUK & Albina A. BRIZHATAYA

Botanical Garden-Institute FEB RAS, Vladivostok, Russia

Москалюк Т. А., Брижатая А. А. Мозаичная структура широколиственных лесов Приморского края на заключительных стадиях сукцессии

We describe the coenotic structure of a permanent plot (50 x 50 m), representing one of the most common types of secondary forest in southern Primorsky Krai: mixed broadleaf forest dominated by *Quercus mongolica*. The plot is located within the Botanical Garden-Institute territory in the vicinity of Vladivostok and contains 60 species of vascular plants: 15 tree species, 12 shrubs, and 33 herbaceous species. Trees are represented by 4 life forms, shrubs by 4, and herbaceous species by 19 different life forms. The oak-dominated plant community has entered the final phase of succession when *Betula platyphylla* is being replaced by *Abies holophylla* and *Pinus koraiensis*. Eight vegetation microcoenoses were identified, of which 3 major ones occupy more than 50 % of the plot area. All the microcoenoses are of secondary type, 7 of them representing a recovery process. Particularly intense recovery occurs in the oak-broadleaf forest microcoenosis with fir understory and forb-sedge ground layer. This microcoenosis is characterized by the highest species and life-form diversity. The lowest species and bio-morphological diversity was observed in Hornbeam-*Eleutherococcus* patch with a sparse herbaceous layer, which approximates the primary deciduous forest type more than any other patches. Coenotic factors are found to be the most critical for the formation of forest patterns. The overall environmental homogeneity under the forest canopy is largely attributable to the edifier influence, resulting in only very subtle differences between the associations. Monitoring the community structure dynamics within the permanent plot will facilitate monitoring vegetation transformation patterns leading to recovery of primary forest type in the circumstances when the recreation pressure is high.

Spatial patterns of vegetation of Japan

Yukito NAKAMURA

Tokyo University of Agriculture, Tokyo, Japan

Накамура Ю. Пространственная структура растительности Японии

One of the features of vegetation patterns in Japanese archipelago is a noticeable difference between the areas adjacent to the Sea of Japan and Pacific Ocean. Within the cool temperate zone occupied by vegetation belonging to the *Fagetea crenatae*, there are two different alliances. *Saso-Fagion crenatae* is characteristic to the Sea of Japan side and *Sasamorpho-Fagion crenatae* – to the Pacific side. In the *Vaccinio-Piccetea* region which represents in Japan the altitudinal belt of conifer forests vicarious to boreal vegetation, the *Abietetum mariesii* predominates on the Sea of Japan side while the *Abietetum veitchio-mariesii* occurs on the Pacific side of archipelago. Due to heavy snow accumulation in winter time in the Sea of Japan side, the edaphic climax vegetation belonging to the class *Betulo-Ranunculetea* is most developed in this area. The latter vegetation type was formed in at the end of period of Pleistocene maximum when the snowy climate was developed in the eastern part of Japan. Before that, because the considerable lowering of sea level during ocean transgression blocked the Tsushima warm current from entering the Sea of Japan, there was a cold episode of climatic history that characterized by predominance of the continental climate in the coastal areas of Sea of Japan. Vegetation reconstruction for the late Pleistocene showed the occurrence of micro- and macrofossils of *Picea maximowiczii*, *P. koyamae*, the relatives of *Picea obovata*. Nowadays, these species occur in isolated areas of Yatsugatake, Chubu district. At the end of Pleistocene Maximum and early Holocene, 13,000-10,000 years BP, with the Sea level rise the Tsushima Sea current entered the Sea of Japan and cold continental climate in the coastal areas in several hundred years has changed to cool temperate with heavy-snow in winters. Japanese cedar, *Cryptomeria japonica* forests spread in colline belt and *Fagus crenata* forests belonging to *Saso-Fagion crenatae* in montane belt. Continental conifer forests of *Picea maximowiczii* and *P. koyamae* disappeared from coastal areas and were replaced here by *Abies mariesii* forests belonging to the *Abietetum mariesii* and *Betula ermanii* forests in combination with tall forbs communities.

The role of oaks in Holocene vegetation of northeastern coast of the Korean Peninsula based on SEM pollen morphology

Natalia N. NARYSHKINA & Tatiana A. EVSTIGNEEVA

Institute of Biology and Soil Science, Vladivostok, Russia

Нарышкина Н. Н., Евстигнеева Т. А. Участие дубов в голоценовой растительности северо-восточного побережья Корейского полуострова на основе морфологии пыльцы, полученной с помощью сканирующего электронного микроскопа

The modern genus *Quercus* L. (Fagaceae) includes more than 500 species of evergreen and deciduous trees and shrubs. Members of the genus have a wide geographical range. During the Holocene, oak-dominated forests were also common. For this purpose, species-level identification of fossil pollen may facilitate reconstructions of palaeovegetation and palaeoclimate. We identified species of *Quercus* fossil pollen grains using scanning electron microscopy: four of them were assigned to deciduous oaks (*Q. mongolica* type, *Q. variabilis* type, *Q. serrata* type, *Q. dentata* type) and two to evergreen oaks (*Q. glauca* type, *Q. sessilifolia* type). Additionally, we observed the continuation of oaks in plant communities of northeastern coast of the Korean Peninsula for the last 10 thousand years. In the Preboreal and Boreal phases (10 300 – 8 000 yr BP), *Q. mongolica* and *Q. serrata* were dominant in deciduous broad-leaved forests. In the Atlantic phase (8 000 – 4 500 yr BP), the deciduous oaks *Q. mongolica*, *Q. dentata*, *Q. serrata* were a significant part in the coastal vegetation. In this time, the deciduous *Quercus* forests prevailed over a wide range in the Korean peninsula. In Subboreal phase (4 500 – 2 500 yr BP), *Q. mongolica* and *Q. serrata* dominated the warm-temperate deciduous broad-leaved tree zone where pollen of evergreen oaks *Q. glauca* and *Q. sessilifolia* were recognized. Most likely, pollen was transported into sediments by wind or water streams from long-distance regions. The study was supported by the Presidium of the Russian Academy of Sciences and Far East Branch, Russian Academy of Sciences (project no. 12-I-П28-01).

Biodiversity of chern forest ecosystems in the perhumid climate of the Sayan mountains

Dina I. NAZIMOVA¹, Dilshad M. DANILINA¹, Nikolay V. STEPANOV²
& Elena V. BORISOVA²

¹ Sukachev Institute of Forest SB RAS, Krasnoyarsk, Russia

² Siberial Federal University, Krasnoyarsk, Russia

Назимова Д. И., Данилина Д. М., Степанов Н. В., Борисова Е. В. Разнообразие черневых лесных экосистем в пергумидном климате Саян

The biodiversity of 'chern' (humid forest with tall forbs in the understorey in southern Siberia) mixed forest and chern taiga of the Sayan mountains have been investigated since 1960 and especially the past decade. Diversity of formations, forest types and series is viewed in charts of climatic ordination and in maps of test areas, made with the help of GIS. To estimate climatic indices of forest vegetation belts, special climatology investigations were conducted. The most important determinant of the distribution of mountain forest ecosystems is that of altitudinal differences of climate which are comparable with zonal ones and even exceed them. Formations of chern forests (with *Pinus sibirica*, *Abies sibirica*, *Populus tremula* but no *Picea obovata*) represent a separate class of ecosystems, which occupy a specific place on the transition line of boreal and cool-temperate orbiomes within Altai-Sayan ecoregion: it is characterized by some unique features of biogeography, physiognomy and functioning under different warmth supply (1800-1200° degree days). Forests are wet enough (700-1500 mm precipitation per year) to qualify them as barrier rainforest ecosystems located on windward slopes of West and East Sayan (350-1300 m a.s.l.). These forests represent relic biota of modern refugia that occur locally also in low-and mid-elevation mountains of Altai and Salair-Kuznetskiy provinces. Some features of structure are similar to Far Eastern subnemoral coniferous forest ecosystems, in spite of differences in Quaternary history and modern regime of climate. Most nemoral species occurring in these forests (*Brunnera sibirica*, *Galium odoratum*, *Cruciata krylovii*, *Daphne mezereum*, *Festuca altissima*, *Frangula alnus*, and *Stachys sylvatica*) belong to European and / or Mediterranean flora at the eastern edge of their distributions. However, some Tertiary relicts (*Anemone baicalense*, *Menispermum dahuricum* and *Waldsteinia ternata*) are of East Asian origin. The data base on 560 vascular species forming the chern forest communities contains original data on their occurrence, and on the species belonging to taxonomic, areal, zonal, biomorphological, ecological groups.

The life span of some species of the genus *Scutellaria* L., Lamiaceae

Maria Yu. NEBAYKINA

Botanical Garden-Institute FEB RAS, Vladivostok, Russia

Небайкина М. Ю. Жизненный цикл некоторых видов рода *Scutellaria* L., Lamiaceae

The genus *Scutellaria* L. is the most detached among the members of the family Lamiaceae. One of the most distinctive features of this the genus is the absence of ether-oil. Of the more than 300 species distributed in temperate regions (except South Africa) and the highlands of the tropics, some are medicinal, melliferous or decorative. The life cycle for the herbaceous plants, including a species of *Scutellaria*, depends on the life span of their underground systems. The article deals with two groups of species: perennials and one- biannual. A similar study for the species of *Scutellaria* is undertaken for the first time. The first group includes species that live more than 50 years (*S. baicalensis* Georgi, *S. cretica* Juz., etc.). The underground system is represented by many-headed caudex with taproot. The above-ground system is represented by elongated shoots. Species included in this group often flower and fruit during the their ontogeny. The species of the second group for the entire life cycle of flower and fruit only once. The second group consists of species with a life span in 1-2 years (*S. strigillisa* Hemsl., *S. tuminensis* Nakai, *S. ussuriensis* (Regel) Kudo et al.) The underground system is represented by long rhizomes with stolons. The collapse of loose clumps of maternal individuals leads to vegetative reproduction and restoration with rapid capture of territory and the weakening of the competitive relationship. Seed reproduction in some years is absent. The above-ground system is similar to the first group of species.

Vegetation map of Kamchatka

Valentina Yu. NESHATAEVA

Komarov Botanical Institute RAS, Saint-Petersburg, Russia

Нешатаева В. Ю. Карта растительности Камчатки

The Kamchatka Peninsula (North of the Russian Far East) belongs to the Boreal taiga zone. Zonal natural vegetation of central Kamchatka is represented by Ajan spruce (*Picea ajanensis*) forests, Cajander larch (*Larix cajanderi*) forests as well as Japan birch (*Betula platyphylla*) and aspen (*Populus tremula*) woods. On the coastal plains and slopes, stone-birch (*Betula ermanii*) forests predominate. Vast territories of mountain slopes are covered by Siberian dwarf-pine (*Pinus pumila*) woodlands and dwarf-alder (*Alnus fruticosa* var. *kamtschatica*) thickets. The mountain tops and ridges are occupied by dwarf-shrub-rich mountain tundra communities. The Kamchatka Isthmus and the Koryak region belong to the Beringian forest-tundra zone. They are characterized by the predominance of dwarf-pine and dwarf-shrub tundra communities that are associated with watersheds. The goal of the present investigation is to prepare a small-scale vegetation map of the Kamchatka Peninsula and the adjacent territories of northern Koryakia and the Koryak upland. Our map was developed using a MODIS space image, digitized topography map, digitized Geobotanical map of the USSR, forest map of the USSR and original field data of about 3000 relevés. This information was combined with field data which helped update the size, shape and contents of the contours. The minimal contour size accepted depending on vegetation cover structure was about 0.04 cm² (at scale 1 : 7 500 000 it will equal 225 km²). The following mapping principles were used to show restored vegetation; zonal vegetation types for the plains; and altitudinal belts for the mountain regions. These belts are: conifer forests, deciduous forests, subalpine dwarf-woodlands (krummholtz), and mountain tundra.

Morphology and germination characteristics of seeds with underdeveloped embryo

Svetlana V. NESTEROVA

Botanical Garden-Institute FEB RAS, Vladivostok, Russia

Нестерова С. В. Морфология и характеристика прорастания семян с неразвитым зародышем

Species with an undeveloped embryo account for ca. 18–20 % of the flora of the Far East. Embryo formation in seed at the maternal plant can stop at different embryogenesis stages. The embryo remains small in comparison with endosperm and mature seeds don't germinate. Seeds of 15 herbaceous spring-blooming species from 5 plant families were studied. Seed linear dimensions varied greatly between the species. *Caltha silvestris* (2.2 x 1.1 mm) and *Hylomecon vernalis* (2.4 x 1.6 mm) have the smallest seeds. *Adonis amurensis* (3.6 x 2.5 mm) has somewhat larger seeds and the largest seeds were observed in *Arsenjevia glabrata* (7.1 x 4.7 mm). Embryo lengths and its development stages are species-specific. In mature seeds of *Enemion raddeanum* and *Ranunculus franchetii* embryo is pyriform 0.1–0.2 mm long. In cordate embryos of *Adonis amurensis* and *Hylomecon vernalis* the primordial cotyledon is clearly visible. The embryo length is 0.2–0.3 mm. Embryo of *Anemonoides reflexa* is 0.3–0.4 mm long, cotyledons compose ca. 30 % of its length. In hypocotyl and cotyledon vascular bundles are evident. After seed dissemination, the embryos are developing during summer and autumn. Postembryonic embryo development lasts from 40–55 days in *Hepatica asiatica* and *Asarum sieboldii* to 110–120 days in *Epimedium macrosepalum* and *Eranthis stellata*. It was found that seeds of *Anemonoides reflexa*, *Gagea nakaiana* and *Lloydia triflora* need morphological endogenic dormancy and have summer or autumn germination. Seeds of *Arsenjevia rossii*, *Plagiorhegma dubia* and *Caltha silvestris* having morpho-physiological type of endogenic dormancy germinate next spring after natural stratification by low winter temperatures. It was revealed that most species produce recalcitrant seeds containing 50–70 % of moisture necessary for embryo's development. After 2–3 months storage seeds lose germination ability.

Genome cryoconservation of the Russian Far East flora plants by seeds, spore and pollen frozen in liquid nitrogen

Svetlana V. NESTEROVA¹, Irina B. KRESHCHENOK² & Irina N. KRESTOVA¹

¹ Botanical Garden-Institute FEB RAS, Vladivostok, Russia

² Amur Branch of Botanical Garden-Institute FEB RAS, Blagoveshchensk, Russia

Нестерова С. В., Крещенок И. Б., Крестова И. Н. Криоконсервация растений флоры российского Дальнего Востока методом замораживания семян, спор и пыльцы в жидком азоте

Long-term storage gene banks are a promising ex situ way to preserve the wealth of natural flora diversity. We investigated the possibility of cryopreservation using liquid nitrogen (-196°C) for seeds, spores and pollen. The seeds of the species studied retained their viability after thawing. However, a differential response of seeds to deep freezing was detected. Statistical analysis did not reveal changes in seed germination of species from the genera *Agastache*, *Artemisia*, *Deutzia*, *Hypericum*, *Potentilla*, *Pinus*, *Papaver*, *Primula*, *Rabdosia*, *Thymus*, *Weigela*. Seed germination of *Ampelopsis* and *Celastrus* species increased by 15–20 %. *Saxifraga* and *Rhododendron* seeds also responded positively. An increase in seed germination in *Astragalus* and *Lespedeza* could be explained by a decline in the proportion of hard seeds. Liquid nitrogen had a negative thermal effect on seeds in the genera *Aristolochia*, *Armeniaca*, *Cerasus*, and *Microcerasus* as indicated by a decrease in germination. Cryopreservation did not affect growth rate and development of plants when plants were grown from the frozen seeds. Although fern spores responded differently to freezing, in the majority of the species spore germination capacity remained unchanged after thawing. However, in some species we observed an increase in germination by 60–80 % and reduced spore germination by more than 40 %. It was revealed that the species of the same genus or family respond differently to spore freezing. Frozen pollen of *Hemerocallis* wild species and cultivars were used in the selection experiment with the cv. "Cork". When using thawed pollen of cv. "Regal Air" the number of ovules and seeds in the fruit increased. In the case of pollination with pollen cv. "Prairie Blue Eyes" seed germination also increased. Flowering plants were grown from the seeds obtained in these pollination experiments.

Analysis of the genetic structure of *Orostachys spinosa* (L.) C. A. Mey (Crassulaceae) populations based on comparisons of cpDNA intergenic spacers trnH-psbA, trnQ-rps16 and rpl32-trnL

Arthur Yu. NIKULIN¹ & Svetlana B. GONTCHAROVA²

¹ Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

² Botanical Garden-Institute FEB RAS, Vladivostok, Russia

Никулин А. Ю., Гончарова С. Б. Анализ генетической структуры популяций *Orostachys spinosa* (L.) C. A. Mey (Crassulaceae) на основе сравнений cpDNA интергенных спейсеров trnH-psbA, trnQ-rps16 and rpl32-trnL

We studied the genetic structure of 9 populations of *Orostachys spinosa*, one of the most widespread species of Crassulaceae in Eurasia, and 1 population of closely related *O. japonica* (Maxim.) A. Berger. The trnH-psbA, trnQ-rps16 and rpl32-trnL regions of cpDNA were successfully sequenced from 77 plants. The total length of concatenated sequence of the three regions was 2135 bp (including indels) for each plant (about 1.5 % of the plastid genome). We found 55 (2.6 %) variable sites, of which 48 were parsimony informative. Analysis of 77 sequences revealed 34 haplotypes. Of these 19 (55 %) haplotypes were private (found in a single individual). The resulting network of haplotypes consisted of five putative haplogroups, combining population and samples from the same region (Bashkortostan, Chita, Magadan, Khabarovsk and Primorsky krai). We found a significant genetic differentiation between populations that corresponded with their geographical distribution and genealogical relationships. A large number of haplotypes per population (5-7), relatively high values of nucleotide and haplotype diversity ($h > 0.85$ and $p > 0.003$, respectively) characterize the populations from the eastern part of the species distribution range (Chita and Primorye territory). Perhaps this indicates that these populations are much older in comparison with those from the western part of the range. We can reason that the species spread in the southern Urals relatively recently. AMOVA revealed high differentiation of the chloroplast genome among the populations of *O. spinosa* ($F_{ST} = 0.84545$, $p < 0.0001$); i.e., the between-population component accounted for more than 86 % of the total variance. These data pointed to the extremely low level of gene exchange between the populations and their significant subdivision. It should be noted that the genetic differentiation within and between populations of *O. spinosa* is comparable with the differentiation between this species and *O. japonica*.

Phylogenetic relationships in the genus *Sedum* L. (Crassulaceae) and closely related genera based on ITS rDNA sequence comparisons

Vyacheslav Yu. NIKULIN¹ & Svetlana B. GONTCHAROVA²

¹ Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

² Botanical Garden-Institute FEB RAS, Vladivostok, Russia

Никулин В. Ю., Гончарова С. Б. Филогенетические отношения в роде *Sedum* L. (Crassulaceae) и близких родах на основе сравнения последовательностей ITS rDNA

Results of phylogeny reconstruction in the subfamily Sedoideae (Crassulaceae) based on 199 ITS rDNA sequences are presented. Prior to alignment a secondary structure model based on the thermodynamic folding was created for each sequence. Models of secondary structure for Crassulacean taxa are generally consistent with those in other groups of eukaryotes: ITS1 – almost half of the nucleotides refers to the single-stranded sites; 4 short stems were revealed with an area of conservation laid prior the stem 1, in entire stem 3 (motif GGCRY-[4-7N]-GGYCAAGGAA, homologous in all groups of plants) and flanking it regions. In ITS2 four stems were identified: the 1st had conservative basal part only, 2nd stem was highly conserved and contained a pyrimidine-pyrimidine mismatch, and the 3rd is the longest stem contained a conserved motif of about 20 nt near its distal part, 4th stem was the most variable. These secondary structures of ITS transcripts helped us to align highly divergent ITS sequences. In the phylogenetic analyses complex evolutionary models and methods of maximum likelihood, neighbor-joining and maximum parsimony were used. In the resulting tree species were grouped into four clades/clusters: "Acre", "Leucosedum", "Sempervivum" and "Aeonium" with members of the genus *Sedum* s.l. to be found in all of these groups. This result clearly indicates the artificial taxonomic nature of this genus. Our analyses revealed a dichotomy between American and Eurasian species of *Sedum* in the most species-rich "Acre" clade. It is notable that sequence divergence between representatives of several genera within the American lineage was significantly lower than that between the Eurasian *Sedum* species. Despite the relatively large number of sequences and their high divergence, we could not obtain a clear picture of relationships within the group because branching pattern of major clades and lineages of the tree remained largely unresolved. Perhaps further expansion of the taxon sampling in critical groups (*Leucosedum* and the Eurasian cluster in "Acre" clade) will aid a more robust phylogeny of the subfamily.

Phylogeny and systematics of Asian *Schefflera* species (Araliaceae): taxonomically useful morphological characteristics and their evolution

Maxim S. NURALIEV^{1,2}, Dmitry D. SOKOLOFF^{1,2} & Galina V. DEGTJAREVA¹

¹ Lomonosov Moscow State University, Moscow, Russia

² Russian-Vietnamese Tropical Center, Hanoi, Vietnam

Нуралиев М. С., Соколов Д. Д., Дегтярева Г. В. Филогения и систематика азиатских видов *Schefflera* (Araliaceae): таксономически значимые морфологические признаки и их эволюция

Asian species of the genus *Schefflera* form a monophyletic group called Asian *Schefflera* Clade within the family Araliaceae. Though several systems of Asian *Schefflera* species were suggested during the Twentieth century, recent investigations showed extensive infrageneric polyphyly. We studied the variation of a number of morphological characteristics within the Asian *Schefflera* Clade and clarified their evolution by mapping them onto our extended molecular phylogenetic tree. Our results indicate that the presence or absence of the septate cavity in stem pith is the only feature, which agrees with dividing of Asian *Schefflera* Clade into two subclades and therefore can be used for description of two monophyletic sections. Then, several other features facilitate description of some minor monophyletic groups. One group differs by an unusual type of leaf blade. Three groups within Asian *Schefflera* Clade are characterized by polymerous flowers in contrast to other pentamerous species. The ancestral type of the inflorescence is a panicle of umbels, which changed twice into double raceme during the evolution of Asian *Schefflera* Clade. The evolution of styles in the gynoeceum, a feature which was broadly used for subdivision of the genus *Schefflera*, is rather complicated: the ancestral state is the presence of the styles, once the styles were lost and then two cases of reversion to the presence of the styles occurred. Thus, the evolution of most morphological features within Asian *Schefflera* Clade appeared to involve more homoplasies (parallelisms and reversions) than it was previously supposed. Nevertheless, employing a complex of features will be helpful for description of monophyletic groups during elaboration of phylogenetic system of the genus *Schefflera*.

Ecological-geographical structure of mountain boreal forests in Siberia and problems of small-scale mapping

Galina N. OGUREEVA

Lomonosov Moscow State University, Moscow, Russia

Огуреева Г. Н. Эколого-географическая структура горных бореальных лесов Сибири и проблемы мелкомасштабного картографирования

Phytogeographic research in the mountains is connected with the development of the three-dimensional structure concept of vegetation cover. Integral manifestation of latitudinal and altitudinal zonal peculiarities of the vegetation distribution is typical for the mountains. The vegetation diversity is reflected in the complex natural differentiation of the mountains and, primarily, in the altitudinal zonal distribution of plant communities. The Siberian Mountains are distinguished by 27 altitudinal zonality types, united in 9 groups of the boreal class, reflecting the connection of mountain biota with zonal vegetation and biogeographical areas. The high-altitude belt is considered as a structural part of the type. The mountain taiga belt has geographic variations which are characterized by complex formations: the Ural-Siberian, Angaridian, Okhotian, Beringian complexes of vegetation formations. Boreal forests are composed of other high-altitude zones: forest-steppe, subtaiga, subalpine and subgoltzy belts. Within the limits of a high-altitude belt boreal forests form complex combinations of forest associations (or various syntaxa), or come in contact with other vegetation types, forming different specific vegetation structures (or territorial units: phytocatenas, high-altitude series, exhibition combinations of phytocatenas). The phytogeographic features structures, reflecting ecological and natural potential of ecotopes, depend on their position in biogeographical systems of the Siberian Mountains. These vegetation structures can be displayed on a small-scale map as autonomous units. There is an experience of a display of structural subdivisions of the boreal forest as chorological units as review maps. The legend of the Circumboreal Vegetation Map based on an ecological-geographical principle may be more informative to show the diversity of boreal forests in the mountains of the Siberia.

Modern vegetation mapping of the boreal forest biome of the Eastern European Russia

**Galina N. OGUREEVA¹, Tatiana V. CHERNENKOVA²,
Michael Yu. PUZACHENKO², Olga V. MOROZOVA³, Elena V. TIKHONOVA³
& Nikita G. KADETOV³**

¹ *Lomonosov Moscow State University, Moscow, Russia*

² *Center for Forest Ecology and Production, Moscow, Russia*

³ *Institute of Geography RAS, Moscow, Russia*

Огуреева Г. Н., Черненко Т. В., Пузаченко М. Ю., Морозова О. В., Тихонова Е. В., Кадетов Н. Г. Современное картографирование растительности бореального лесного биома восточной европейской России

Display of the regularities of spatial vegetation heterogeneity to review vegetation maps is fundamental. Mapping algorithm for modeling of the Eastern boreal forest is provided. This schema includes the use of terrestrial studies to obtain medium-scale regional vegetation maps. Results of the regional assessment of diversity and state vegetation are used to display the structure of vegetation to small-scale map of boreal forests. It is discussed the principles of classification of the boreal forests for the vegetation map modeling. To create the spatial vegetation model in discrete categories (classes, types) must be coordinated allocation of these categories for the various taiga regions. For the vast territory it is necessary to attract the large volume of the field measurements that is a limitation to the use of expert methods of selecting discrete classes. The use of numerical methods enables to carry out the joint analysis of large data sets, allowing you to supplement the methods expertise and objectivity. As a result of the quantitative analysis of specific units reserved at each stage of the study should be corrected using expert classification approach (ecologic-morphological, ecological and dynamic or floristic) based on the hierarchical levels of classifications. Classification levels have to be agreed upon with the biogeographic and ecological subdivisions of the biosphere. The classification units should be sufficiently "physiognomic" for automated interpolating data, which is based on informative sources, such as multi-spectral remote sensing (REMOTE SENSING), digital elevation models (DEM), climatic characteristics etc. It is necessary to compare the results of spatial vegetation modeling, with the classification units for the creation of vegetation map of circumboreal forests.

A topography-based model of the vegetation cover of the Lanzhinskie Mountains

Alexander M. OMELKO, Anna N. YAKOVLEVA

Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

Омелько А.М., Яковлева А.Н. Модель растительного покрова Ланжинских гор на основе топографических переменных

By means of the GAM technique it is possible to create detailed maps of the potential vegetation for regions that are difficult to access. This is particularly important for wide mountain areas of Northeast Asia, where such maps have never been created. High-resolution DEMs permit increased prediction accuracy and modeling of complex vegetation patterns. Most vegetation types in the area are controlled mainly by the moisture regime and by regimes of sediment transport and accumulation. The relatively small amounts of rainfall in the continental climate are distributed spatially by relief elements. This creates a wide range of soil moisture regimes: from very dry, with a prolonged period of moisture deficit, to wet, without moisture deficit during the growing season at all. Therefore, moisture appears to be a critical resource in this climatic region, and it is a main differentiating factor for the vegetation. The map of potential vegetation, obtained satisfactorily, reflects altitudinal zonation and inter-zonal patterns of vegetation distribution. The area occupied by some vegetation communities is overestimated, however, due mainly to insufficient DEM resolution.

Creation of long-term storage seed bank of woody species as a real way of their gene pool preservation

Tatiana P. OREKHOVA

Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

Орехова Т. П. Создание долговременного хранилища семян древесных растений как реальный путь сохранения их генетического пула

The forests of the Russian Far East Federal District constitute 55 % of total country forestry resources. So the task of preservation of forests genetic resources under the conditions of expanding ecological disasters area after fires and cuttings has become one of crucial importance. Further development of a network of specially preserved natural areas and additional localization of reservations of different functions (species preservation *in situ*) cannot really protect woodlands from harmful pests and numerous annual fires in Siberia and the Russian Far East. To preserve the woody species gene pool, one should take urgent measures based on state-of-the-art scientific achievements and worldwide experience. The seeds of 27 Far East woody plants represented by coniferous (softwood) and deciduous (hardwood) species as well as by rare and medicinal bushes and lianas were investigated. The processes of seed natural ageing are known to occur under any storage conditions. Determination of main reserve substances in the seeds was performed by the biochemical methods presented below. For example, the qualitative changes after 10 years of storage were found for virtually all isomers of fatty acids of the *Pinus koraiensis* seeds. These changes inevitably produce a loss of the seeds storage vitality, which is reduced by up to 71 % during the storage period. The investigation indicates the following advantages of seeds cryopreservation: 1) preservation of seeds vitality for longer periods; 2) genetic modifications in seeds is minimal, compared to standard storage. We believe that it is not reasonable to recommend cryopreservation of large batches of seeds stored for forest restoration purposes for the period between abundant harvests, since such seeds can be stored efficiently at low temperatures.

The use of microsatellite loci in the population and genetic analysis of *Larix* species

Nataliya ORESHKOVA

Sukachev Institute of Forest SB RAS, Krasnoyarsk, Russia

Орешкова Н. В. Использование микросателитных локусов в популяции и генетический анализ видов *Larix*

Genetic diversity of SSR-markers was studied in 6 populations of Siberian larch (*Larix sibirica* Ledeb.), 2 populations of Gmelin's larch (*Larix gmelinii* (Rupr.) Rupr.) and 4 population of Cajander's larch (*Larix cajanderi* Mayr). Seven pairs of nuclear microsatellite loci were used for this analysis (bcLK056, bcLK066, bcLK224, bcLK260, bcLK235, UBCLXtet-1-22, UAKLly6) (Khasa et al. 2000, Isoda & Watanabe 2006; Chen et al. 2009). Loci bcLK056, bcLK235, bcLK260 and UAKLly6 were highly polymorphic (15-24 alleles), loci bcLK066, bcLK224 and UBCLXtet_1-22) were less polymorphic (6-8 alleles). There were 103 allelic variants detected in 365 individuals of three species of larch. *L. cajanderi* populations from Kamchatka Territory that are characterized by lower microsatellite diversity (HO=0.360, HE=0.562) compared to *L. sibirica* (HO=0.447, HE=0.632) and *L. gmelinii* (HO=0.362, HE=0.697). This is, evidently due to history of distribution, isolation and the specific climatic conditions of growth of the species in this region. According to the AMOVA results, the variability proportion characterizing the differences between three *Larix* species was twice as high (15 %) than that accounting for among-population differences within the species (6 %). Differentiation of the populations of three species of larch based on SSR-markers exceeded 12 % (FST = 0.121). Significant correlation of the genetic distances with the geographic distances between populations was found ($r = 0.835$, $P < 0.01$).

Vegetation of Yunnan, China

Xiaokun OU

Institute of Ecology and Geobotany, Kunming, Yunnan, China

Оу С.-К. Растительность провинции Юннань, Китай

Yunnan, situated in southwest part of China, has unique diversified landforms and vegetation types. A classification system with 12 vegetation types, 45 vegetation subtypes and 445 formations in Yunnan was established in the 1980's in the book of 'Yunnan Vegetation', and more than 45 new formations was found subsequently. Vegetation can be summarized using six characteristics: 1) vegetation types in horizontal latitude are diversified and rare; 2) vegetation distribution has its vertical belt in different areas; 3) nonzonal vegetation has its obviously characters; 4) different original mountain vegetation types are still distributed in Yunnan; 5) zonal and nonzonal vegetation types are crosslinked in different areas from tropical to temperate areas; 6) the flora is rich and comparatively diverse, unique and originating in different areas. With human disturbance, the vegetation change was heavily influenced by regional population density, population growth rate and market demand, and change in landuse policies. Forest reduction was due to logging and expansion of land used for cultivation. Increased forest area can be attributed to the change of vegetation from scrub or shrub-grassland to forest.

Methods of studying the ecology of forest-forming species using the example of Korean pine (Primorsky Territory)

Boris S. PETROPAVLOVSKY

Botanical Garden-Institute FEB RAS, Vladivostok, Russia

Петропавловский Б. С. Метод изучения экологии лесообразующих видов на примере кедра корейского (Приморский край)

Here I present a method for determining the level of correspondence of vegetative cover to chief environmental factors, and a method of constructing ecological passports of forest vegetation. The application of these to the conditions of Primorsky Territory confirms a highly effective determination of optima and tolerances of forest-forming species, based on elements of the forest structure (forest taxonomic descriptions, large-scale design of forest plantations), topographic and climatic maps. In confirmation, ecological characteristics of 6 dominant forest-forming species of Primorsky Krai are presented. To serve as an example a table is presented which is used to demonstrate tolerances and ecological optima for one of the leading factors in the environment, and to construct ecological passports of forest-forming species. Korean pine (Korean "cedar"), *Pinus koraiensis* Siebold et Zucc. is one of the main forest-forming species in the southern Russian Far East. Korean pine does not extend high in the mountains: occurring on the south slopes of the Sikhote-Alin no higher than 700-750 m a.s.l. and on the north slopes no higher than 500-600 m. Korean pine and the forests where it is found usually occur in the middle and lower altitudinal belts of mountain slopes. Forests with Korean pine grow in diverse conditions of topographic relief and substrate both in river valleys and in mountains. The ecological optimum in Primorsky Territory for Korean pine is: growth degree days – from 1 600 to 2 600°C; the Selyaninov's Hydrothermal Coefficient – from 1.6 to 2.2; annual precipitation – more than 800 mm; altitude above sea level – 200-700 m; slope exposure – all aspects; steepness of slope – up to 20°.

The project "Garden of friendship" in Botanical Garden-Institute of FEB RAS, Vladivostok, Russia

Boris S. PETROPAVLOVSKY

Botanical Garden-Institute FEB RAS, Vladivostok, Russia

Петропавловский Б. С. Проект "Сад дружбы" в Ботаническом саду-институте ДВО РАН (Владивосток, Россия)

Environmental protection, creation of favorable conditions for human life, enhancing its ecological and botanical level, creating a favourable environment to preserve the health of the population are the main priorities of the national goals of creating an enabling environment, which is one of the conditions for optimization of social goals. Of particular relevance is the optimization of environmental quality for large cities, such as Vladivostok, especially in view of the increasingly large population of Vladivostok in the coming years (not less than 1.5 million). Attractiveness of the Botanical Garden will increase attendance while creating the Garden of friendship, which consists of set of miniature (a quarter of a hectare) botanical gardens – Pacific countries of the Pacific basin. There is a real opportunity to create a unique i small Botanical Garden consisting of Pacific plants. The geopolitical location of Vladivostok is the best location not only to create traditional gardens of our closest neighbours, but also the more remote countries in the Asia-Pacific region. In Vladivostok there are 18 foreign missions at the consulates and other diplomatic status in Asia Pacific countries which could assist in the establishment of a "small area of botanical gardens". Together they can create the "Garden of friendship". One of the primary elements of structural parts of the "Garden of friendship" must be a Japanese garden.

Proposal for the 5th level of the legend of circumboreal vegetation map for the Northern Russian Far East

Alexei POLEZHAEV

Institute of Biological Problems of the North FEB RAS, Magadan, Russia

Полежаев А. Н. Предложение пятиуровневой легенды карты циркумбореальной растительности для севера российского Дальнего Востока

The Institute of Biological Problems of the North FEB RAS has a digital vegetation map of the North of the Russian Far East scale of 1 : 200 000. There are 164 subdivisions of the map legend. The map of scale of 1 : 7 500 000 was created on the basis of this map by means of generalization (combining small polygons into larger ones). Subdivisions of this map taking in account first level of the CBVM legend are listed further.

- C.1. Lichens, stone mountain deserts and their combination with fragments of mountain tundra, nival meadows, shrubs, siberian dwarf-pine, open forests.
- C.2. Lichens, dwarf shrub, sedge-cotton-grass mountain tundra with inclusions of mountain meadows.
 - D.1. Siberian dwarf pine (*Pinus pumila*) mosses, lichens, forbs, sedge-cottongrass, mountain prostrate formation and shrub thickets.
 - D.2. Larch (*Larix cajanderi*) mosses, lichens mountain open forests and forests.
 - D.3. Birch (*Betula ermanii*) dwarf shrub, forbs mountain open forests and forests.
 - D.4. Spruce (*Picea ajanensis*) mountain forests.
- E.1. Larch (*Larix cajanderi*) mosses, lichens, dwarf shrubs, forbs, sedge-cotton-grass open forests and forests.
- E.2. Birch (*Betula ermanii*) dwarf shrubs – forbs open forests and forests.
- E.3. Siberian dwarf pine (*Pinus pumila*) mosses, lichens, forbs, sedge-cottongrass prostrate formation.
- G.1. Meadow-tundra vegetation of the Commander Islands.
- K.1. Sedge (*Carex subspathacea*) marsh meadows.
 - L.1. Grassy mire.
 - L.2. Dwarf shrub grassy-mosses mire.
 - L.3. Plain hilly pool complexes mire.
 - L.4. Sedge-cotton-grass tundra-mire.
- N.1. Larch (*Larix cajanderi*) dwarf shrub, forbs, mosses, lichens and forests combining with shrubby grass large hilly mire and small hilly complex mire.
- N.2. Birch (*Betula ermanii*), dwarf shrub, forbs forests.
- N.3. *Chosenia arbutifolia*, poplar, willow, birch, alder (*Alnus hirsuta*, *Betula platyphylla*, *Populus suaveolens*, *Salix schwerinii*, *S. udensis*) forbs flood plain forests combining with meadows.
- N.4. Shrub thickets (*Betula middendorffii*, *Duschekia fruticosa*, *Salix alaxensis*, *S. arctica*, *S. fuscescens*, *S. glauca*, *S. hastata*, *S. krylovii*, *S. phlebophylla*, *S. pseudopentandra*, *S. pulchra*, *S. saxatilis*) mosses, lichens, forbs combining with meadows and tundra.

Chromosome studies on the flora of the Russian Far East

Nina S. PROBATOVA

Institute of Biology and Soil Science, Vladivostok, Russia

Пробатова Н. С. Хромосомные исследования флоры российского Дальнего Востока

Chromosome studies on the vascular flora in the Russian Far East (RFE) were initiated in the late 1950s. Now the RFE is the most studied region of Russia in this aspect. New evidence was obtained that sea coasts are a zone of speciation. In the RFE we observe isolation of coastal ecotypes of the widely distributed continental taxa. Since 2007, when the book on karyology of the flora of Sakhalin and the Kurils was issued, we have in total 374 species with chromosome numbers (CN) from Sakhalin and 294 species from the Kurils. The Index of CN for the Primorskii Territori is under preparation and summarizes the CN studies in this territory since 1962 (1247 species from 593 genera). Recently in *Moehringia lateriflora* the diploid cytotype ($2n = 24$) was found in the RFE, though $2n = 48$ is more common for this species, which is widely distributed from E Europe to N America and ecologically variable; its 24-chromosome race probably is connected with sea coasts. *Draba cinerea* in Sakhalin (Schmidt Peninsula) and in the continental part of the RFE (the Nylan River basin, Khabarovskii Krai) showed $2n = 2x = 16$: this is southern limit of the species range. Most probably, *D. cinerea* originated in this part of its present range and migrated to the north, by forming polyploid races ($2n = 48, 56, 64, 80$). Coastal species *Scrophularia grayana* has $2n = 20$ in Iturup and Moneron Islands, but $2n = 40$ – in the continental RFE (South Primorye): these data indicate that the insular part of *S. grayana*'s range could be more ancient than the continental one. Intraspecific karyological polymorphism (in CN and ploidy levels) was also revealed in *Acorus calamus*, *Agrostis trinii*, *Allium senescens*, *Bidens parviflora*, *Calamagrostis brachytricha*, *Clinopodium chinense*, *Lysimachia davurica*, *Oenanthe javanica*, *Phyllanthus ussuriensis*, *Poa skvortsovii*, *P. sichotensis*, *Potentilla discolor*, *Scrophularia maximowiczii*, *Scutellaria strigillosa*, *Vicia unijuga*, *Waldsteinia maximowicziana*. The study was funded by Russian Fund for Basic Research (RFBR), projects 04-04-49750, 07-04-00610, 11-04-00240.

Late Holocene vegetation dynamics of Muravyev-Amursky Peninsula (on the basis of soil profile palynological data)

Boris F. PSHENICHNIKOV¹, Marina S. LYASHCHEVSKAYA²
& Nina F. PSHENICHNIKOVA²

¹ Far Eastern Federal University, Vladivostok, Russia

² Pacific Geographical Institute FEB RAS, Vladivostok, Russia

Пшеничников Б. Ф., Лящевская М. С., Пшеничникова Н. Ф. Позднеголоценовая динамика растительности полуострова Муравьева-Амурского (на основе пыльцевых данных почвенного профиля)

In order to explore vegetation dynamics of Muravyev-Amursky Peninsula in late Holocene, we sampled the Southern, Western, and Eastern areas using a test pit in each area (no. 5-09, 7-09, 3-09 respectively). Analysis of spore-pollen spectra of genetic horizons was carried out for polygenetic burozems or PB (the burozem profile comprises one modern and one buried elementary soil profile). Palynological data allowed us to reconstruct paleoclimatic conditions of Muravyev-Amursky Peninsula by Klimanov's (1981) informational-statistical method, based on statistical correspondence between the percentage of different taxon pollens in present-day pollen complexes and climatic conditions, under which the said complexes were formed. Spore-pollen spectrum compositions of PB genetic horizons in each sample area give evidence of anthropogenic influence on vegetation dynamics, resulting from intense logging of coniferous-broadleaved forests when the Peninsula was cultivated. Subsequent fires and developing erosion and solifluction contributed to formation of polygenetic burozems; PB formation was also due to severe climatic conditions of the final phase of the Short Ice Age. The age of PB buried humus-accumulative horizon [AY] fully agrees with this thesis (test pit 5-09 – 150±60 years old (Ki-16630)). Spore-pollen spectra of horizons BM[AY] (test pit 5-09), [AYBM] (test pit 3-09), and [BM] (test pit 7-09) indicate colder-than-modern climatic conditions which gave rise to birch forests with fern-herb ground cover. These horizons are characterized by high content of soil skeleton matter and stone material, which is the result of severe climatic conditions, prevailing at the time of horizon formation. Overall, our research data show that the Peninsula vegetation dynamics in late Holocene is due to both anthropogenic and climatic factors. This research is supported a grant of the Russian Foundation for Basic Research, project no. 12-05-00017, and by grants of the Presidium of the Far Eastern Branch of Russian Academy of Sciences, project no. 12-III-A-09-208, 12-III-B-09-200.

Role of wind activity in the forest opening in Québec's southern portion of the spruce lichens woodland, Québec, Canada

André ROBITAILLE

Université Laval, Saint-Laurent ile d'orléans, Québec Canada

Робиталь А. Роль ветра в формировании лесных редин в южной части квебекских лишайниковых редкостойных ельников, Квебек, Канада

This study presents the impacts of wind activity following forest fires over several thousand square kilometres in the southern portion of the spruce lichens woodlands in the province of Québec. This phenomenon had not been studied, and compared to other regions of the Canadian boreal zone wind activity in this area it is unique in its intensity and progression. Effects of wind, sand dunes and blowouts, occur in many areas between the 51st and 53rd degree of northern latitude, corresponding to the transition between the spruce-moss forest and spruce-lichen woodlands. The study uncovered huge areas composed of water-deficient sandy soils. There are indications that increased wind activity triggered by forest fires led to the development of aeolian erosion and sand dunes in this region. This phenomenon leads to the loss and degradation of forest soil and most likely contributes to opening up forest cover over a long period of time, notably by a return to a primary stage of soil development. According to our observations, wind effects increase following forest fires in this region. In addition, a hypothesis was derived that the effect of the wind in winter can damage the forest regeneration and maintains low density forests. For the Circum Boreal Vegetation Mapping project we suggest to integrate into the legend a specific codification which would allow indicating this type of natural disturbance when it affects vast territories. It should be the same for regions with higher rates of fire recurrence and those periodically affected by insect epidemics.

On systematics of the genus *Chrysosplenium* L. in Primorskii region

Anastassia G. RYAZANOVA

Botanical Garden-Institute FEB RAS, Vladivostok, Russia

Рязанова А. Г. К систематике рода *Chrysosplenium* L. в Приморском крае

The genus *Chrysosplenium* L. is represented by perennial herbs and includes 57 species distributed mainly in the temperate latitudes. This paper presents results of study of two species belonging to the same series – *Pilosa*. According to regional Flora guidebooks and summaries, one of them was identified as *Ch. pilosum* (described in 1859 by Maximowicz), the second – as *Ch. whoroschilovii* (described by Nechaeva in 1976). A comprehensive analysis of the literature, herbarium specimens and living plants showed that *Ch. pilosum* had been attributed with the presence of rosettes of leaves at the ends of vegetative shoots that, in fact, not characteristic to this species. Due to this misunderstanding, plants with this feature belonging to *Ch. villosum* Franch. were mistakenly identified as *Ch. pilosum*, and plants without leaf rosettes were redescribed by Nechayeva as a new species – *Ch. woroschilovii*. This is not surprising, because in the flowering period, when vegetative shoots are not yet developed, both species (*Ch. pilosum* and *Ch. villosum*) have very similar habitus and are similar by their structure of the flowers, capsules and seeds. Hara (1957), who studied *Ch. pilosum* in China, Japan and Korea, found this species highly polymorphous and described three varieties referring *Ch. villosum* in synonyms for one of them. However, our study shows that clear differences in the structure of the underground organs and vegetative shoots as well as in phenological stages and in geographical distribution allow to consider the presence of two different species – *Ch. pilosum* and *Ch. villosum*. The name *Ch. woroschilovii* should be referred to the synonyms for *Ch. pilosum*.

The CBVM legend and its application for mapping the boreal vegetation of Canada

Jean-Pierre SAUCIER¹, Ken BALDWIN², William B. MEADES²,
Del MEIDINGER³, Will MACKENZIE⁴, André ROBITAILLE¹, Peter ULIGH⁵

¹ *Université Laval, Québec, QC, Canada;*

² *NRCAN, GLFC, Sault Sainte-Marie, ON, Canada*

³ *Meidinger Ecological Consultants Ltd., Victoria, BC, Canada*

⁴ *British Columbia Ministry of Natural Resource Operations, Smithers, BC, Canada*

⁵ *Ministry of Natural Resources, Sault Sainte-Marie, ON, Canada*

Сосье Ж.-П., Болдвин К., Мидес У. Б., Майдингер Д., Макензи У., Робиталь А., Улих П. Легенда проекта CBVM и ее применение для картирования бореальной растительности Канады

The need for a common legend to map the whole boreal was clearly stated since the beginning of the Circumboreal mapping project (CBVM). Discussion took place in different meetings. At the Helsinki meeting of 2010, a draft legend structure was agreed and regional team had to test it with pilot mapping projects. At the Akureyri meeting in 2011, regional teams shared their views about classification and mapping of boreal vegetation, comparing the results of the different pilots. From those exchanges, a reviewed legend structure was designed. The proposed legend for CBVM has six hierarchical levels (from the broadest to the most detailed): 1) Formation Type, based on broad physiognomy and structure (forest, woodlands, ...); 2) Formation Group, based on structure and physiognomy and reflecting main climatic conditions (zonal vegetation) or site, edaphic, or topographic conditions (extrazonal, azonal); 3) Formation Dominant Growth Forms (evergreen, deciduous, ...); 4) Bioclimatic Subdivision, based on climatic parameters and bioclimatic indices as reflected by vegetation, usually North–South broad zonation; 5) Geographic Variants, based on species or ecosystem distribution, usually West–East broad zonation; and 6) Plant Community based on species composition. Level 5 is the most detailed level that is to be mapped at the scale of 1 : 7 million that was chosen for the circumboreal map. Level 6 is related to site characteristic and intended to be mapped at a more detailed scale. Following the Akureyri meeting, the Canadian team extended and revised their pilot projects in order to fill the legend structure and test its relevance in our vegetation condition. The Canadian National Vegetation Classification, a project involving the federal and provincial jurisdictions of Canada, provided the knowledge about the vegetation associations that was required to discriminate the Bioclimatic Subdivision and the Geographical Variants for Canada. From the Canadian pilots arose the need for a landscape unit framework to express the dominant potential vegetation at the level 6 of the CBVM..

Ecological niches of Poaceae species invasive in the Russian Far East

Vitaly P. SELEDETS¹ & Nina S. PROBATOVA²

¹ Pacific Geographical Institute FEB RAS, Vladivostok, Russia

² Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

Селедец В. П., Пробатова Н. С. Экологические ниши видов семейства Poaceae на российском Дальнем Востоке

The Russian Far East (RFE) is the area of intensive penetration of invasive plant species into natural vegetation. In the RFE 472 species from 91 genera of Poaceae are known, of which 92 are invasive. The aim of the study was to reveal the pattern of transformation of ecological niches of some invasive Poaceae species in the RFE. The study is based on the individualistic ecological concept of Ramensky, and was conducted at three levels. One-dimensional level: the evaluation of habitats by means of ecological scales. Two-dimensional level: the elaboration of ecological ranges of the species. Multi-dimensional level: two-dimensional level was expanded to ecological niches by adding more ecological axes (up to 8). The ecological niches of invasive Poaceae species in the RFE were elaborated and examined. Multi-dimensional analysis was used to reveal parameters of ecological niches, which permit the species to be more or less invasively active in the monsoon zone of the RFE. The evaluation of species habitats in East Europe and East Asia was made in degrees of ecological scales and further transformed into percentages. This permitted calculation of the ecological reserve of each invasive species in the RFE and to rank the species according to their degree of invasive activity. The low degree of invasive activity indicates the island type of invasion (restricted) in the RFE: *Agrostis capillaris*, *Anthoxanthum odoratum*, *Deschampsia cespitosa*, the continental type of invasion (large degree): *Alopecurus arundinaceus*, *A. pratensis*, *Calamagrostis epigeios*, *Leymus chinensis*, and the high degree of invasive activity – regional type of invasion (the largest): *Agrostis gigantea*, *Bromopsis inermis*, *Dactylis glomerata*, *Phleum pratense*, *Poa annua*, *Schedonorus pratensis*.

Features of essential oils of *Mentha arvensis* L. from the European part of Russia and Indo-China

Olga V. SHELEPOVA & Tatjana V. VORONKOVA

Tsitsin Main Botanical Garden, Moscow, Russia

Шелепова О. В., Воронкова Т. В. Особенности ароматических масел *Mentha arvensis* L. из европейской части России и Индокитая

Mentha arvensis L. (Lamiaceae) is widely used in world production of essential oil with a high menthol content. The species has a Eurasian boreal type of distribution. It is characterized by a significant ecological and geographical variability – about 11 varieties of this species are distinguished. This type is polymorphous which is reflected in the composition of essential oil. The main components of the oil of the European species *M. arvensis* were menthone (67.9 %), terpinen-4-ol (7.2 %), iso-menthone (4.7 %), 1,8-cineol (3.6 %), menthol (2.1 %). Among the minor components prevailed β -caryophyllene (1.7 %), γ -terpinene (1.1 %), pulegone (1.1 %), carvone (1.1 %), germacrene D (1.1 %), iso-menthol (1.0 %), β -pinene (1.0 %). In the composition of the essential oil of species *M. arvensis* of the natural flora by Indo-China dominated menthol (56.5 %). Also presented in significant amounts menthone (20.8 %), iso-menthone (12.2 %), menthyl acetate (5.8 %), piperitone (3.9 %), iso-menthol (1.8 %) and D-limonene (1.5 %). Thus, morphologically similar varieties of *M. arvensis* from different geographical origin had fundamentally different composition of major components of essential oil. This fact indicates that the specific mechanisms of synthesis of essential oil within a species may be closely related with the ploidy level (chromosome numbers) of species *Mentha arvensis* L. from different geographical origin. This work is supported by grant of RFFR no. 11-04-01820.

A distributional study of vascular plants in the Korean Peninsula

Joonhwan SHIN, Youmi LEE & Seunghwan OH

Korea National Arboretum, Gyeonggi-do, Republic of Korea

Шин Ю., Ли Ю., Ох С. Изучение распространения сосудистых растений на Корейском полуострове

Since the implementation of the Convention on Biological Diversity, viewpoints for biological resources have rapidly changed. In particular, research for conservation and sustainable usage of plants have been steadily conducted through many years. The Korea National Arboretum has been conducting a long term research on domestic and endemic plants of Korea to complete a list of plant species and specimen collection. Up to date about 2 600 species, 53 % of 4 940 known Korean plant species, have been inventoried through "A distributional study of vascular plants in the Korean Peninsula" from 2003 to 2010. This national research project has completed surveys in 640 sites during past 8 years. About 60 researchers from the KNA and 9 universities have participated in the project. In total, about 120 000 distribution data of plant species have been accumulated so far. The species list and distribution data were collected from references and field surveys. Specimens of every single species identified from the survey sites are collected as vouchers. All of the voucher specimens collected through the surveys are deposited at KNA and the other participating universities. The project is now in its second phase. The second project started from 2011 in order to collect distribution data and specimens of 2 280 species that were not included in the first project. Another research, a distributional study of Korean rare plants, has also been conducted as well as the main project. The project will be completed with all the specimens and distribution data of every vascular plant species of the Korean Peninsula by 2016. In addition, a distributional research for about 400 species known from North Korea will be conducted in the near future with help and support from China, Russia and Japan.

Structure of the nuclear ribosomal intergenic spacer region (IGS) in some species of Crassulaceae DC

Valentina V. SHOKHRINA¹ & Andrey A. GONTCHAROV²

¹ Far Eastern Federal University, Vladivostok, Russia

² Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

Шохрина В. В., Гончаров А. А. Особенности структуры межгенного спейсера ядерной рибосомной ДНК (IGS rDNA) у некоторых представителей сем. Crassulaceae DC.

Eukaryotic rRNA genes are arranged in tandem repeats separated by intergenic spacer region. Typically in plants IGS varies in length from about 2 kb in to 12 kb and contains different internal subrepeats. Some of these repetitive sequences contain promoters and enhancers duplications playing an important role in transcription and processing of rRNA genes. We studied structure organization and evolution of the IGS rDNA in some representatives of the family Crassulaceae and assessed this region as a potential phylogenetic marker. IGS was amplified with primers as a complement to the conservative areas of 26S (domains G19 and H1) and the 5' end of 18S rDNA. Successful amplification and sequencing of the spacer was achieved only in 57 out of 117 studied specimens. These sequences ranged from ca. 1400 bp to 220-280 bp only in some specimens due to the extensive deletions in non-coding spacer region (predominantly 3'ETS) and in the 3' end of 26S exon. Only 120-280 bp corresponding to the 5'ETS (if present) were relatively conserved in the sequences obtained. Search for subrepeats in the crassulacean IGS revealed only short (10-15 bp) repeated motives positioned 140-600 bp apart from each other. It is unlikely that these motives represent true subrepeats that are typically much longer (> 100-150 bp) and follow one another in the IGS sequence. It should be noted that in the specimens studied TATA-motif (binding site of RNA polymerase I) was not conservative. Three variants of this motif were found and in some short sequences it was completely lacking. The sequences were grouped into 8 types according to the presence of deletions in the 3' end of 26S exon and specific TATA-motif sequence. Several sequences in our data set that shared features of two different IGS types. This fact suggests that some populations may have originated by hybridization. It is likely that rDNA intergenic spacer in the family Crassulaceae evolves by three different ways: extensive deletions in the spacer sometimes involving flanking portion of the 26S exon, point mutations and indels in the 5'ETS and exchange of large portions between parental IGS sequences during hybridization.

Reciprocal invasions in East Asia and eastern North America: shared phylogeography and ecology, contrasting invasion pathways

John A. SILANDER, Jenica ALLEN

University of Connecticut, Storrs, CT, USA

Силандер Дж. А., Аллен Дж. Взаимные инвазии в Восточной Азии и восточной Северной Америке: общие филогеография и экология, различные пути инвазий

East Asia and eastern North America share a large number of reciprocally introduced invasive plant species. Each region views many of these species as the most invasive and problematic of their naturalized alien flora. However, this seeming symmetry and the fact that both regions share strong phylogeographic linkages and are dominated by similar natural community types, belie the striking differences in life histories and functional traits of the worst invaders in each region. The most serious plant invaders in eastern North America tend to occur in and around forests and are perennial, woody, bird-dispersed species with moderate levels of shade tolerance. In stark contrast, the invasive species in East Asia originating from eastern North America are primarily short-lived herbaceous plants that colonize ruderal sites and the edges of croplands. Why this asymmetry occurs is not well understood despite past attempts to synthesize data. Using regional or county-wide databases of invasive alien species, we have been able to document and contrast differences among countries and between regions in the groups of species that have become invasive and their functional traits. We have supplemented this with remotely sensed data on land-use geometry and the history of introductions across countries. We can explain many of the dissimilarities in the invasive alien floras between regions by striking differences in: historical plant trade and associated international commerce, timing in alien plant introductions, horticultural landscape and cultural aesthetics, and current and past land-use patterns and geometry.

A boreal vegetation map of Magadan region and Chukotka as a part of CBVM project

Nadezhda V. SINELNIKOVA

Institute of Biological Problems of the North FEB RAS, Magadan, Russia

Синельникова Н. В. Карта бореальной растительности Магаданской области и Чукотки как часть проекта "Карта циркумбореальной растительности"

A boreal vegetation map of the Russian North-East is created on the key area as a part of CBVM. The main aims of the study are to determine basic units of vegetation for the scale 1 : 7 500 000 and to create a legend. The legend is based on a two-level hierarchial principle traditionally used in the Russian large-scale vegetation mapping. The basic units of the legend are physiognomic or combined physiognomic-floristic. The draft legend for Eurasian boreal vegetation (Ermakov & Bohn 2011) is also used for the study. Zonal southern hypoarctic tundras within the boreal zone include tundra, dominated by low dwarf shrubs, lichens and mosses and moist tundra, dominated by tussock cottongrass, sedges and mosses alternating with tundra mires. Tundra vegetation covers the northern part of the territory (Anadyr region) where we can see the border of Circumpolar Arctic Vegetation map. Alpine vegetation within the boreal zone includes sparse vegetation of herbs, lichens, mosses and liverworts in the upper part of the alpine belt. Mountain tundra, dominated by dwarf shrubs and lichens is one of the main types of vegetation of Northeast Asia. Subalpine and low-mountain vegetation is mainly represented by subalpine prostrate trees (krummholz), shrub vegetation and subalpine open larch woodlands. *Pinus pumila* and *Larix cajanderi* are the main species here. Numerous mosses and lichens form the ground layer. Plains and lowlands are covered by open larch forests with *Betula* spp. understory and open hygrophilous larch woodlands alternating with mires. Permafrost depressions and lakes are common on the territory. Azonal vegetation within boreal zone includes mires and floodplain vegetation. Mires dominated by cottongrasses and sedges mainly occur on lowlands and permafrost depressions. Oligotrophic mires, dominated by sedges and dwarf shrubs with *Sphagnum* moss cover are frequent on the flat mountain slopes. Floodplain poplar, willow and larch forests form the riverside vegetation along Kolyma, Anadyr and other large rivers. Small rivers and streams form riparian corridors with mixed vegetation on gravel bars and willow shrubbery on low floodplain terraces.

Epiphytic lichen flora of Korean pine-broadleaf and fir-spruce forest of South Sikhote-Alin

Irina F. SKIRINA & Fedor V. SKIRIN

Pacific Geographical Institute FEB RAS, Vladivostok, Russia

Скирина И. Ф., Скирин Ф. В. Эпифитная лишайниковая флора кедрово-широколиственных и пихтово-еловых лесов южного Сихотэ-Алиня

South Sikhote-Alin Korean pine-broadleaf and fir-spruce forest epiphytic lichen flora is notable for its wide biological diversity. This area contains 525 species of epiphytic lichen, which belong to 132 genera, 51 families and 11 orders. At the present time it has been studied quite thoroughly and includes 83.8 % of the known species of Russia's Far East epiphytic lichens. Korean pine-broadleaf and fir-spruce epiphytic lichen flora of southern Sikhote-Alin form a part of the lichen flora of Holarctic temperate forest zone. Systematic analysis data allowed characterizing epiphytic lichen flora as boreal-nemoral with a significant participation of the East Asian species. The lichen flora include both a large number of common lichen and rare species, part of which is located near the border of their natural habitats where the core of the region's protected species is concentrated. Species diversity of epiphytic lichen flora represents favorable climatic conditions of the region for epiphytic lichens and the presence of a large amount of available phorophytes. This conforms to the region's topography and vegetation and reflects its geographical position within the limits of two geobotanical areas: South-Okhotsk dark conifer forest and the East Asian coniferous-deciduous forest.

Multispecies forests of the southern Far East: resilient forest ecosystems and refugia for biodiversity

Vladimir E. SKVORTSOV

Lomonosov Moscow State University, Moscow, Russia

Скворцов В. Е. Многовидовые леса южного Дальнего Востока: устойчивые лесные экосистемы и рефугиумы биоразнообразия

A new method has been developed for delineating high conservation value forests in the southern Far East that uses the quantity of canopy-forming woody species as an indicator of heightened vegetative diversity. Forest inventory materials can be analyzed for the presence of this indicator. The composition and structure of multispecies stands (those containing more than 6 canopy-forming species) in Korean pine-broadleaf forests of Primorsky Krai was investigated. Floristic diversity increased proportionally with the quantity of woody, canopy-forming species and reached its highest levels in multispecies stands. The number of finds of rare species (including *Taxus cuspidata*, *Galium paradoxum*, *Paeonia oreogeton* and *Dioscorea nipponica*) was disproportionately high in multispecies stands and significantly lower in stands with less canopy-forming species, even those with 6 species. The vertical structure of the studied forest ecosystems became more complex with increasing quantity of canopy-forming species; in multispecies stands continuous vegetative cover (that is, without distinguishable canopy layers) was frequently observed, similar to structures observed in undisturbed tropical forests. Multispecies stands often have a mosaic structure with gaps of various sizes. The herbaceous and shrub layers in multispecies stands demonstrate a lack of a clear dominant and a complex mosaic structure.

Differentiating taxa of vascular plants in the botanical and geographical zonation of Amurskaya Oblast

Valentina M. STARCHENKO & Irina G. BORISOVA

Amur Branch of Botanical Garden-Institute FEB RAS, Blagoveshchensk, Russia

Старченко В. М., Борисова И. Г. Дифференцирующие таксоны сосудистых растений в ботанико-географическом районировании Амурской области

Amurskaya Oblast (363 700 km²) is a mountain-plain area located in the southern Far East of Russia. The natural environment varies greatly in different parts of the region due to its geographic and orographic situation as well as the complicated history of development. Botanical and landscape materials collected within 1988-2011 have allowed botanical and geographical zoning of Amurskaya Oblast, based on the principles developed by Sochava. Proposed geobotanical units are supported by extensive botanical information, including taxonomic, geographic and coenotic analysis. This approach makes it possible to designate the completed zoning as botanical and geographical. Two geobotanical regions were accepted at the territory of Amurskaya Oblast: Circumboreal and East Asian regions. Within the Circumboreal region three subregions were separated: Okhotsk-Kamchatka, Amur-Sakhalin and East Siberian; the latter included three provinces: Nyukzha, Gilyuy-Tok, Tukuringra-Soktakh. Within the East Asian region two subregions were identified: Dahurian and Manchurian with 4 provinces: Zeya-Bureya, Upper Amur, Turan-Mamyn, Amur-Ussuri. Within regions and subregions 52 districts were separated. Brief physical-geographical and geobotanical data are provided for each region, subregion, and province. The differentiating families and genera are noted for the regions and differentiating species are listed for subregions and provinces. This work was supported by RFBR, grant no. 11-05-98527.

Monitoring *Pinus sibirica* natural regeneration in virgin and secondary forest stands of the west Sayan barrier-rain mountain landscapes

Nikolay Yu. STASHKEVICH

Sukachev Institute of Forest SB RAS, Krasnoyarsk, Russia

Сташкевич Н. Ю. Мониторинг естественного возобновления *Pinus sibirica* в девственных и вторичных лесных насаждениях Восточно-Саянских барьерно-дождевых ландшафтов

Barrier-rain landscapes of the West Sayan north macroslope are the unique complex of habitats where the relict and mutant forms of Siberian pine were found. A wide amplitude of absolute heights (500-1800 m a.s.l.) in Tanzibey forestry causes a typological variety of forests grouped in 4 altitudinal belt complexes (ABC):

- light coniferous small-leaved subtaiga ABC. Detached groups of *Pinus sibirica* regeneration appear due to nutcracker (*Nucifraga caryocatactes* L.) activity and disappear owing to regular fires. *P. sibirica* produces 300-800 seedlings/ha in a wide spectrum of habitats.

- low mountain chern ABC with aspen, Siberian pine and fir. It is the ecological optimum of *P. sibirica*. Outside the sites with large herbs and ferns the *P. sibirica* regeneration is more successful (1000-1200 seedlings/ha);

- middle mountain-taiga ABC with Siberian pine and fir. The regeneration process is more stable in all series, and the extensive spreading of hypnum mosses favours this process.

- high mountain subalpine open woodlands with Siberian pine and fir. The quantity of *P. sibirica* regeneration is close to 800-1200 seedlings/ha. The germination of *P. sibirica* from nuts carried by nutcracker from the lower belts is sufficiently successful, but its further growth depends on many other factors like short growing season, thick snow cover and extreme soil moisture.

The forest inventory data are confirmed by long-termed accounting data of *P. sibirica* new generation on the permanent test plots in 2009-2011. In all of 9 test plots placed in chern ABC and on the border of chern and sub-taiga ABC the regeneration of Siberian pine is poor (100-500 seedlings/ha) regardless of tree structure (it presents different combinations of Siberian pine, fir and aspen). It is caused by competition with large herbs and ferns, fir regeneration and mature trees. Only in fir forests with small-herbs and sedge cover the quantity of recently appearing *P. sibirica* new generation is higher (a little less than 3500 seedlings/ha). The main cause of this phenomenon is the nutcracker activity and raised nut productivity on the nearest sites with the absence of fern and large herbs competition.

Endemism of boreal rainforest regions of the Sayan mountains

Nikolay V. STEPANOV

Siberian Federal University, Krasnoyarsk, Russia

Степанов Н. В. Эндемизм флоры региона дождевых бореальных лесов Саян

The level of endemism of flora characterizing the humid areas of Sayan mountains (area occupied by boreal rainforests) is highly unusual. Of the total 849 species in the Western Sayan over 15 % are endemic. Among the many endemic relic species, indicating the age of the flora, are *Chrysosplenium filipes*, *Ch. ovalifolium*, *Ch. sedakowii*, *Fritillaria dagana*, *Brunnera sibirica*, etc. However, much of species are neoendemic, recently separate from the mother taxa. These include: *Corydalis sajanensis*, *Betula rotundifolia*, *Pilosella kebesheensis* and among several others. The endemic chorological structure is dominated by species common throughout South Siberia (12 %). Noticeably fewer local taxa: endemic of Western Sayan, Altai-Sayan and others make up just over 3 %. According to zonal-structure of flora alpine endemics (30 %) predominate, penetrating from highlands to the woodlands, and sometimes in the lower zone-belts: *Veronica sajanensis*, *Aconitum tanzybeicum*, *Aquilegia borodinii* etc. Quite rich are nemoral (20 %) montane (16 %) and light-coniferous-forest (10 %) zonal groups. A similar pattern is observed in the East Sayan. In general, a complex structure and richness of endemic species points to a long and complicated history of the formation of rain forest flora of Sayan.

A phytosociological study in the Eurasian steppe, focusing on the junction of two subregions

Kohei SUZUKI¹, Abdisalam JALALDIN², Nurbay ABDUSALIK²,
Tsagaanbandi TSENDEEKHUU³, Narantsetsegiin AMARTUVSHIN⁴,
Takashi KAMIJO¹ & Toru NAKAMURA¹

¹ University of Tsukuba, Ibaraki, Japan

² Xinjiang University, Urumqi, China

³ National University of Mongolia, Ulaanbaatar, Mongolia

⁴ Institute of Botany, Mongolian Academy of Science, Ulaanbaatar, Mongolia

Сузуки К., Джалалдин А., Абдусалик Н., Цендеехуу Ц., Амартувшин Н.,
Камидзо Т., Накамура Т. Фитосоциологическое исследование Евразийской
степи на стыке двух субрегионов

The Eurasian steppe extends as a broad belt across the continent from Hungary to northeastern China (Archibold 1995). It can be divided into two main subregions along the line of Altai Mountains: the Black Sea-Kazakhstan and Central Asian subregions (Lavrenko & Karamysheva 1993). However, the transition of species composition between these two subregions is still unclear. Therefore, this study described the plant communities at the junction of these two subregions. We recorded the species composition in the steppe of northern Xinjiang, China, in 2009, and of western Mongolia in 2010 and 2011, using the phytosociological methods of Braun-Blanquet (1964). In addition, plant communities were classified based on their differential species (Muller-Dombois & Ellenberg 1974). Consequently, two main plant communities were classified: the *Stipa capillata*-*Festuca sulcata* community and the *Agropyron cristatum*-*Artemisia frigida* community. The *Stipa capillata*-*Festuca sulcata* community was found in northern Xinjiang, but not in western Mongolia. The species differentiating this community were *Stipa capillata* and *Festuca sulcata*. Conversely, the *Agropyron cristatum*-*Artemisia frigida* community was found in western Mongolia, but not in northern Xinjiang. The species differentiating this community were *Agropyron cristatum*, *Artemisia frigida*, *Caragana pygmaea*, *Stipa krylovii*, etc. We concluded that the Eurasian steppe is divided at the community level along the Altai Mountains. However, a community that was dominated by *Stipa krylovii* was also distributed in northern Xinjiang. Therefore, some species appeared to cross the Altai Mountains and there are some exceptional communities.

Naturalized plants in Hokkaido and the Kurils

Hideki TAKAHASHI¹, Vyacheslav Yu. BARKALOV², Alexander A. TARAN³

¹ The Hokkaido University Museum, Sapporo, Japan

² Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

³ Sakhalin Branch of Botanical Garden-Institute, Yuzhno-Sakhalinsk, Russia

Такахаси Х., Баркалов В. Ю., Таран А. А. Натурализовавшиеся растения на Хоккайдо и Курилах

Endangered and naturalized species are the main themes (now known as Red List and Blue List, respectively) in conservation biology. In this presentation, we show the present conditions of naturalized plants in Hokkaido and the Kuril Islands. At present, there are about 2 200 vascular plant species including about 600 naturalized ones (ca. 27 %) in Hokkaido, and about 1 400 species including about 200 naturalized ones (ca. 14 %) in the Kurils. The number and percentage of the naturalized plants reflect the temperature, area size, and the human activities in these regions. Hokkaido is and/or will become one of the main sources of supply of naturalized plants to the Kuril Islands. Hokkaido published the "Blue List of Hokkaido" in 2010, in which all the naturalized species have been categorized by their potentially harmful influence on the natural ecosystems. The most harmful naturalized plants have been categorized as A2 rank; those are *Aegopodium podagraria* (Apiaceae); *Ambrosia artemisiaefolia* var. *elator*, *Cirsium vulgare*, *Hieracium aurantiacum*, *H. pratense*, *Hypochaeris radicata*, *Leucanthemum vulgare*, *Rudbeckia laciniata*, *Solidago altissima*, *Solidago gigantea* var. *leiophylla*, *Taraxacum officinale* (Asteraceae); *Nasturtium officinale* (Brassicaceae); *Robinia pseudoacacia*, *Trifolium pratense*, *Trifolium repens* (Fabaceae); *Iris pseudacorus* (Iridaceae); *Plantago lanceolata* (Plantaginaceae). In order to preserve the natural vegetation in the Kuril Islands, the present conditions of these harmful naturalized plants from Hokkaido shall be monitored in the Kurils. New aliens also must be studied. We hope to compile and publish a Blue List in the Kurils

Introduction to the Circumboreal Vegetation Mapping (CBVM) project

Stephen S. TALBOT

U.S. Fish and Wildlife Service, Anchorage, USA

Тэлбот С. С. Карта циркумбореальной растительности

The Circumboreal Vegetation Mapping group is a subgroup within the Conservation of Arctic Flora and Fauna (CAFF) Flora Group devoted to mapping the vegetation of the boreal region (scale 1 : 7.5 million). Vegetation maps of the circumboreal region currently exist at a wide variety of scales using many legend approaches; these were developed by numerous authors for a wide variety of disparate applications but were not integrated into a unified system. The development of the CBVM through a unified legend approach aims at understanding the boreal in a new way that looks beyond the confines of regional approaches. In this respect it will form an important information, assessment and planning tool for solving nature and environmental protection problems at a global level.

The need for a CBVM was discussed at an international circumpolar vegetation workshop in Norway (2004) where participants resolved to develop a unified international method for classifying and mapping boreal vegetation expanding the area covered by the *Circumpolar Arctic Vegetation Map* far to the south. Following this workshop the CBVM group met in several workshops in Canada, Faroe Islands, Finland, and Sweden. At the CBVM workshop in Iceland (2011), participants agreed to test a preliminary legend in several prototype areas of Alaska, Canada, and Russia; these results and those of all CBVM workshops document and record our approach and progress; they may be accessed online at:

http://www.caff.is/publications/view_category/17-caff-s-flora-group-cfg

The CBVM will portray potential natural vegetation rather than existing vegetation that is commonly generated by classification of satellite imagery. Although still under development, the CBVM Vegetation Legend has been strongly influenced by the principles used in the development of the Map of the Natural Vegetation of Europe. The proposed legend will be a hierarchy that at the highest levels should reflect the most essential regularities common for the boreal zone of both continents (Eurasia and North America). Moving down the hierarchy, the legend will reflect more detailed divergence in regional vegetation structure and composition.

Coastal vegetation of Izembek National Wildlife Refuge (NWR), westernmost Alaska Peninsula, Alaska

Stephen S. TALBOT¹ & Sandra L. TALBOT²

¹ U.S. Fish and Wildlife Service, Anchorage, USA

² U.S. Geological Survey, Anchorage, USA

Тэлбот С. С., Тэлбот С. Л. Прибрежная растительность национального природного рефугиума Изембек, восточная оконечность полуострова Аляска

A phytosociological analysis of the coastal vegetation of Izembek National Wildlife Refuge was carried out in the major beach and dune communities. Fifty-one relevés represent the range of structural and compositional variation in the matrix of vegetation and landform zonation at seven locations. Data are primarily analyzed using multivariate methods that include a numerical procedure that produces results similar to traditional phytosociological tabular classification. Six vegetation types are distinguished: 1) *Honckenya peploides* beach, 2) *Leymus mollis*-*Senecio pseudoarnica* beach meadow, 3) *Lathyrus japonicus* var. *maritimus*-*Leymus mollis* foredune meadow, 4) *Aconitum maximum*-*Heracleum maximum* meadow, 5) *Fragaria chiloensis*-*Leymus mollis* dune meadow, and 6) *Empetrum nigrum*-*Festuca altaica* dune heath. The structure, composition, and environmental features of these types are interpreted in response to a complex gradient primarily influenced by distance from the sea, pH, and elevation. The vascular flora is dominated by circumpolar species and also includes floristic elements with a strong eastern Asian and Eurasian distribution. Phytogeographic comparison of Izembek NWR plant communities with those of eastern Kamchatka and the central and western Aleutian Islands indicates a close relationship to beach and beach meadow types and a weaker relationship to meadow types. This is the first use of the relevé method in the western Alaska Peninsula and provides a basis for future comparison with other studies.

Projecting potential habitats of *Pinus koraiensis* in East Asia and assessing the impact of climate change

Nobuyuki TANAKA¹, Katsuhiko NAKAO¹, Jong Hak YUN²,
Ikutaro TSUYAMA¹ & Motoki HIGA¹

¹ Forestry and Forest Products Research Institute, Tsukuba, Ibaraki, Japan

² National Institute of Biological Resource, Incheon, Republic of Korea

Танака Н., Накао К., Юн Ё.-Х., Цуяма И., Хига М. Моделирование потенциальных местообитаний *Pinus koraiensis* в Восточной Азии и оценка воздействия климатических изменений

Statistical models such as GAM projecting potential habitats of plants are useful tools for assessment of plant geography as well as for assessment of climate change impact. Comparison of potential habitats with fragmented distributions for a plant species may suggest causes of limited distributions of the species. Although spatial data on plant species distribution and environmental factors such as climatic ones are necessary for modeling, species distribution data with high accuracy are much more difficult to collect. In the case of a species occurring in more than one country, it is better to collect distribution data covering the whole range of the species to accurately project its potential habitats. In order to assess impact of climate change on natural population of *Pinus koraiensis* in East Asia, we made a statistical model, MARS (Multivariate Adaptive Regression Splines), in which we used the distribution data (DCL) made by digitizing the map of its whole range (Critchfield & Little 1966) for a response variable and four climatic indices prepared in Worldclim (Hijmans et al. 2005) as explanatory variables. We also used three independent datasets of distribution of the species in China (CDD), Japan (PRDB) and Korea (KRDB) to validate the model. CDD was made by digitizing the distribution map of the species included in Higher Plant of China (Qingdao Publishing House, 1999-2005) while PRDB and KRDB were our original databases of vegetation plots. Accuracy of the model was considered good because AUC values based on CDD, PRDB and KRDB were 0.97, 0.92 and 0.81 respectively. The projection of potential habitats under current (1950-2000) and future (2080) climate conditions indicated that the area of habitat would become small in actual distribution areas of northeastern China, central Japan and Korea. This species occurring in unsuitable habitats after climate change would decline gradually. Potential habitats would shift northward and become larger in Russia. Suitable habitats in the areas around the boundary between China and Korea would be sustained under the future climate, suggesting future refugia for the species.

AFLP analysis of genetic variability of the three species of rhododendrons in Southern Siberia and Far East

Nataliya A. TIKHONOVA¹ & Mariya A. POLEZHAEVA²

¹ Sukachev Institute of Forest SB RAS, Krasnoyarsk, Russia

² Institute of Plant and Animal Ecology UB RAS, Ekaterinburg, Russia

Тихонова Н. А., Полежаева М. А. Анализ генетической изменчивости трех видов рододендрона из южной Сибири и Дальнего Востока

Rhododendron is the most numerous genus in Ericaceae family. In Russia this genus is represented by 21 species. Species that are difficult to distinguish morphologically provide the special interest for research. The most widespread species in Siberia and Far East are *Rhododendron dauricum* L., *Rh. ledebourii* Pojark. and *Rh. sichotense* Pojark. However, in literature there is still no consensus about the taxonomy of this species. We undertook AFLP analysis of genetic variability of 9 populations of putative species *Rh. dauricum*, *Rh. ledebourii* and *Rh. sichotense* from Baikal region, West and East Sayan, Altai and Seaboard. In general 90 individuals of three rhododendron's species were genotyped on the 213 loci. The estimation of interspecific distinction through χ^2 criteria on frequency of locus occurrence shows significant difference between all compared species. A scatter-plot, constructed with the help of analysis of normal coordinates in terms of Nei's genetic distances also confirms clear distinction of population sample into three disjoint groups: 1) populations of *Rh. ledebourii*; 2) populations of *Rh. dauricum*; 3) populations of *Rh. sichotense*. The degree of species' distinction agrees completely with their geographic location and distance from each other. *Rh. ledebourii* grows in mountains of West Sayan and Altai; *Rh. dauricum* grows in mountains of East Sayan, North Baikal region and Transbaikalia; *Rh. sichotense* grows on a slope Sichote-Alin and neighboring part of seashore. These investigations confirm the specific status of three rhododendron's species and are consistent with the geographical habitat.

Stand structure and disturbance history of old-growth Korean pine-leaved forests of the Sikhote-Alin Mountains

Olga N. UKHVATKINA & Alexander M. OMELKO

Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

Ухваткина О. Н., Омелько А. М. Структура и история разрушений древостоя старовозрастных кедрово-широколиственных лесов Сихотэ-Алиня

Coniferous-broadleaf forests of the Russian Far East cover around 720 000 km². Such forests can include in their composition up to 30-40 tree and shrub species (with around 20 being common) and more than 70 herbaceous species. All these species demonstrate varying ecological requirements, levels of reaction to changes in growing conditions, life strategies and influence on their surroundings. The combination of topographical complexity (providing a diversity of microclimatic conditions) and the varying life strategies and ecology of woody species increases the structural complexity and diversity of these vegetative communities. Our research was conducted on two permanent sample plots in the Sikhote-Alin mountain range (Verkhneussurisky Research Station of IBSS FEB RAS and Sikhote-Alin Biosphere Reserve, Primorsky Territory, Russia). The study plots are located in unaltered mature forests typical of Korean pine-dominated communities at the northern end of the Korean pine range, where it forms stands in mixture with spruce and broadleaf tree species. Stand history was analyzed with the use of the "boundary-line release criterion" methodology (Black & Abrams 2003). For analysis of horizontal stand structure we used the function of paired correlation (Wiegand & Moloney 2004). The analysis was conducted with the help of Programita software. Analyses identified periods of partial decays of stands on two sample plots. Decays occur simultaneously on both plots at intervals of about 40 years and cause accelerated growth of trees of all stand layers. The undergrowth location is not determined by the canopy layer trees placement, but associated with previously existing gaps. Development of conifer undergrowth occurs in several stages: first, it accumulates under the stand canopy, then (after decay) extends up to the canopy sublayer and upper canopy layer. Thus, formation and separation of generations (Ivashkevich 1927) may not depend on tree absolute age. Periodic improvements of conditions leads to a stepwise development of the trees, with fast growth alternating with long periods of suppression.

Hybridogenesis as an analog of adaptive evolution

Viktor M. URUSOV¹, Boris S. PETROPAVLOVSKY², Larisa I. VARCHENKO³

¹ Far Eastern Federal University, Vladivostok, Russia

² Botanical Garden-Institute FEB RAS, Vladivostok, Russia

³ Pacific Institute of Geography FEB RAS, Vladivostok, Russia

Урусов В. М., Петропавловский Б. С., Варченко Л. И. Гибридогенез как аналог адаптивной эволюции

The present stage of evolution is to some extent related to hybridization, in particular, as opposed to introgression process of specialization, rotation of the graduated system of climate-stadial interstage (Velichko 1963). There are at least 4 periods of hybridization. 1. Neogene hybridization occurring at different times within itself. Gave to the early Miocene oil of new sections (Bobrov 1978), pine trees and can be traced not only at the level of well-distinguishable taxa of species rank (*Pinus x funebris*, *Maianthemum x intermedium*, etc.), but at least subgeneric. Due to tectonic causes global cooling starting and drying of the climate. 2. Eocene – Early Pleistocene hybridization of autochthonous species without deviation to the parent form (*Pinus x densiflora x thunbergii*, *P. x densata*, *Juniperus x nipponica*, *J. x litoralis*, *Quercus x mc-cormickii*, *Anemone x amurensis*, etc.) caused by a general cooling. 3. Late Pleistocene due to mixing of flora and landscapes in the glacial – interglacial periods in the "introgression" floras (Bobrov 1961, etc.) – the combination of species from different latitudinal zones and altitudinal belts. Especially important for hybridization processes is the intense cooling and aggregation of vegetation, releasing new ecological niches, such as dried sea shelf. 4. Holocene and the latest period of hybridization – has given the population – a mixture without the expressed morphological type (*Juniperus x coreana*, *Corylus x brevituba*, *Alnus x mayry*), as well as single hybrid organisms (*Salix caprea x S. hultenii*, *Betula davurica x B. ovalifolia*, *Rosa rugosa x R. davurica*, *Lespedeza cyrtobotrya x L. bicolor*, etc.).

Taxonomy and biogeography of pyrenomycetous fungi occurring around the Sea of Japan

Larissa N. VASILYEVA

Institute of Biology and Soil Science FEB RAS, Vladivostok, Russia

Васильева Л. Н. Таксономия и биогеография пиреномицетов бассейна Японского моря

One of the most interesting regions in northeastern Asia is the area around the Sea of Japan. Many pyrenomycetous fungi are restricted to this territory, and a number of economically important pathogenic fungi are only known from north-eastern China, Japan, Korea and southeastern Russia. Unfortunately, rather often they are confused with other species, so phytopathologists cannot recognize them and thus develop the appropriate measures of control. Some species described originally from the Russian Far East – *Biscogniauxia mandshurica* Lar. N. Vassiljeva, *B. maritima* Lar. N. Vassiljeva, *Cryptosphaeria exornata* Lar. N. Vassiljeva, *C. venusta* Lar. N. Vassiljeva – were found later in China, Korea or Japan. *Diaporthe corylina* Lar. N. Vassiljeva and *Leucodiaporthe acerina* M. E. Barr & Lar. N. Vassiljeva are only known from two localities in China and Russia or Korea and Russia, respectively. *Podostroma gigantea* S. Imai described from Japan was found later in the Russian Far East. It is most probable that these species were distributed more widely before the Glacial Age and then were pushed by glaciers to the Pacific Ocean where the Sea of Japan appeared after the separation of Japan (as the island arc) from the continent, about 25-15 millions years ago (i.e. during the last glaciation). It was supposed that host plants of many fungi became more widely distributed again after the Glacial Age, but unlike their host plants, the fungal species were restricted to the area of the Sea of Japan. It seems that this area appeared to become a kind of a 'trap' for fungi which are associated with air current directions in their dispersal, while the air currents are often dependent upon sea currents. The main circulation of waters in the Sea of Japan is created by two currents. One of these (The Tsushima Current) is warm, another one (The Liman Current) is cold. In fact, these two currents create a closed system of water and air flows which transfer the fungal spores, and this factor might help explain the narrow biogeographical pattern known in some fungi around the Sea of Japan.

Geometric morphometrics analysis of shape variation in the seed scales of *Pinus pumila* populations in Kamchatka peninsula

Valentina P. VETROVA

Kamchatka Branch of Pacific Geographical Institute FEB RAS,
Petropavlovsk-Kamchatsky, Russia

Ветрова В. П. Морфометрический анализ изменчивости формы семенной чешуи в популяциях *Pinus pumila* Камчатского полуострова

Methods of multivariate analysis of data obtained employing geometrical morphometry were used to compare samples from the 12 Kamchatka populations of *Pinus pumila* (Pall.) Regel. The similarity of the sample plots by the shape of seed scales was estimated based on the set of 7 landmarks. Scales belong to symmetric structures, therefore landmarks have been placed on one side of the scales: 3 fixed landmarks at the base, at the apex and at the greatest width and 4 outline points (semilandmarks) placed at regular intervals using angular algorithm. The shapes of the scales were compared using coordinates of the landmarks obtained by generalized least squares Procrustes superimposition and sliding baseline registration. For an estimation of the statistical significance of shape differences between locations, we used Goodall's F-test, Hotelling's T²-test, and Bootstrap resampling. Principal components analysis and canonical variates analysis were performed. Two principal components of variability accounted for about 80 % of variability in the scale shape. The first component is related mainly to the variability in length and reflection of scale tips and width of scales (43.5 % of total variability), and the second – to a variation in scale stretching (35.2 % of total variability). Partial Procrustes distances between pairs of mean shapes from different populations varied from 0.009 to 0.125. Results of a geometrical morphometry of seed scales suggest that *P. pumila* was dispersed in the region from the coniferous forest refugium – the central Kamchatka depression (CKD). Cluster analysis yielded two groups of populations originating from north and south of CKD. The method of geometrical morphometrics provides a more accurate estimation of seed scale shape variability than classical morphometrics and, thus, is a promising analytical approach to the analysis of phenotypic variability of conifers.

New species of *Aspidistra* (Ruscaceae) from one of southernmost locality for genus in Vietnam, diversity of flower morphology and pollination

Nikolay A. VISLOBOKOV

Lomonosov Moscow State University, Moscow, Russia

Вислобоков Н. А. Новый вид *Aspidistra* (Ruscaceae) из одного из самых южных местообитаний рода во Вьетнаме: разнообразие морфологии цветка и опыления

South China and Northern Vietnam is a hot spot of biodiversity for genus *Aspidistra*. It is remarkable that many new species were discovered during late decades. In 1998 Conran and Tamura recognized 11 species distributed in Himalayas, Indochina, S China and SW Japan, later Tilich (2008) reported about 93 species. We described a new species of *Aspidistra* (*Aspidistra phanluongii* N.Vislobokov) from Dong Nai province in southern Vietnam. It is one of southernmost locality for genus. Some other southern species of *Aspidistra* have any morphological similarity with new species, and may be form closely related group of species together.

Species of *Aspidistra* are characteristic, but not conspicuous herbs in certain types of forests in Southeast Asia. Flowers and fruits of *Aspidistra* are situated close to the ground level, often covered by leaf litter. Flowers of *Aspidistra* are extraordinarily diverse, and characters of flower morphology are most important in identification of species. It is logical to hypothesize that the diversity of flowers is conditioned by various adaptations in pollination biology of *Aspidistra* species. Despite rapid discovering of new species, field observations of flowering plants from wild environment are actually absent.

Different author's data suggest that pollination biology of *Aspidistra* species could be highly interesting and diverse. But it is strongly biotic pollinated. Different suggestions about *Aspidistra*'s pollinators exist in literature: amphipods, collembolas, fungus gnats (Diptera) and even slugs. Our observation shows that it may be flies (Phoridae family). Probably different types of pollination take part in varied flower morphology, that also may be geographically or taxonomical significant.

The areal of *Symphyllocarpus exilis* Maxim. (Asteraceae), an endemic species of Amur river basin

Anna N. VOROBYEVA

Amur Branch of Botanical Garden-Institute FEB RAS, Blagoveshchensk, Russia

Воробьева А. Н. Ареал *Symphyllocarpus exilis* Maxim. (Asteraceae) – эндемика бассейна Амура

Symphyllocarpus exilis Maxim. is an obligate hydrophilic ephemeral plant. It is a rare endangered species and taxonomic relict. This species grows only on flooded and sandy banks, silty shallows of the Amur, Ussuri and Sungari rivers. The analysis of the literary data, herbarium of Institute of Botany of Chinese Academy of Sciences (PE) (Beijing), Northeast Agricultural University (Harbin), Institute of Biology and Soil Sciences of Far East Branch of Russian Academy of Sciences (VLA) (Vladivostok), Institute of Water and Environmental Problems of Far East Branch of Russian Academy of Sciences (Khabarovsk), Bolshekhekhtzirsky State Natural Reserve (Khabarovsk region, Bychikha) and author's own researches provided sufficient detail about the distribution of the species in Russia and China to create a distribution map of the species. The plant area is disjunct and consists of two parts: Amur and Songari. The growth of *S. exilis* in the flood plains of the middle reaches of the Amur and Ussuri rivers (from Khabarovsk to Tzimmermanovka) and of the middle reaches of the Sungari river (the vicinities of Harbin and Girin) is well established. Dr. A. P. Nechaev has refuted opinion that the species grows in the lower reaches of the Amur river. There is no evidence that the plant grows in the upper Amur river and the lower reaches of the Songari river. The herbarium specimens identified earlier as *S. exilis* belong to other species.

Plant invasions of protected areas in Taiwan

Shan-Huan WU¹, Chang-Fu HSIEH¹, Jenn-Kuo TSAI¹ & Ting-Huei LU²

¹ National Taiwan University, Taipei, Taiwan

² Association of Biodiversity and Conservation of Taiwan, Taipei, Taiwan

Ву Ш.-Х., Хсие Ч.-Ф., Цай Дж.-К., Лу Т.-Х. Инвазии растений в охраняемые территории Тайваня

To understand plant invasions in protected areas in Taiwan, a field survey was launched from 2010 to 2011. This project aimed to investigate naturalized flora and invasion intensity of different habitats in protected areas. Among 47 protected areas ranging from sea level to 3 000 m a.s.l., 91 sample quadrats (1 km²) were established, and habitat types of each quadrats were classified. Species and cover of native and naturalized plants of randomly selected 10 m² plots were collected for each habitat type. The invasion intensity was estimated by naturalized species/total flora (%). A total of 1 551 species belonging to 776 genera and 183 families were recorded, of which approximately 86 % were angiosperms. Naturalized species contributed about 15.47 % of the mostly dicotyledonous total flora. Major families contributing to the naturalized flora were Asteraceae, Poaceae, Fabaceae, Euphorbiaceae, and Solanaceae, while dominant genera were *Ipomoea*, *Solanum*, *Rumex*, *Conyza*, and *Paspalum*. Tropical America (51.25 %) was the major source of naturalized flora, followed by Europe and China. Among 17 habitat types categorized in the survey, the most invaded one was abandoned field (invasion intensity: 52.75 %), followed by arable and fallow lands. Dominant naturalized species characterized these different habitats, e.g. *Bidens pilosa*, *Ageratum houstonianum*, *Mikania micrantha*, *Conyza symatrensis*, and *Solanum americanum*. According to the results, plant invasions seemed to be restricted to frequently disturbed areas, which were usually located on the outskirts of the protected areas. On the other hand, invasion intensity dropped dramatically in plantations and untilled forests and grasslands adjacent to areas subjected to anthropogenic effects. We assume that disturbances may provide transportation, empty niches and unused resources for naturalized species to flourish, and this assumption may be supported by biological traits of dominant species, such as airborne small seeds, vegetative growth, etc. Unfortunately, the factors relevant to resistance to plant invasions of these protected areas are still unknown, and that warrants further studies.

Lichens and vegetation complexes of the Tioul-Shaman Mt. (Khabarovsk Territory, Russia)

Lidia S. YAKOVCHENKO¹ & Alexander V. ERMOSHKIN²

¹ Botanical Garden-Institute FEB RAS, Vladivostok, Russia

² Institute of Water and Ecological Problems FEB RAS, Khabarovsk, Russia

Яковченко Л.-С., Ермошкин А. В. Лишайники и растительные комплексы горы Тиуль-Шаман (Хабаровский край, Россия)

The lichen diversity and vegetation complexes of the Tioul-Shaman Mt. (1 181 m a.s.l.) were studied. The mountain belongs to the foothills of North Sikhote-Alin Mts. Adjacent to the Amur River channel. Lichens from this mountain were not previously studied. Within the study area we found high taxonomic (205 species). This is related to highly variable substrates and habitats. The lichen biota of the forest belt is essentially boreal with some East-Asian characteristics such as several species of *Nephromopsis*, *Cetrelia*, *Lobaria*, *Myelochroa*, etc. The presence of amphi-oceanic taxa as *Pseudocyphellaria crocata*, *Sticta limbata* and *Fuscopannaria ahneri* reflects the location of the study area within the zone of Pacific influence. In relic mountain oak forests as well as in mixed floodplain forests, we detected the most frequent occurrence of East-Asian nemoral taxa. The lichen biota of cliffs is rather diverse being associated with a lengthy history of substrate development. We found 3 new species for the southern Far East – *Calvitimela aglaea*, *Lecanora intricata* and *Umbilicaria proboscidea*, 2 new species for the Far East – *Fuscidea asyndeta* and *Lecanora achariana*. The lichen biota of krummholz *Betula ermanii* forest is of interest due to several rare taxa of crustose species such as *Pertusaria carneopallida*, *Biatora sphaeroidiza*, *B. subduplex* and *Caloplaca pyracea*. The latter three species were collected for the first time in this area. *Pycnora leucococca* has a Eurasian-American, rather broadly distributed in boreal zone, but was found in southern Far East the first time. In addition, *Lecanora subintricata* and *Rinodina olivaceobrunnea* are also new species for the southern Far East, together with *Lecanora saligna* for the Far East. Thus, the lichen biota of the Tioul-Shaman Mt. is of manifold interest for biodiversity. As well as being rich in nemoral species, there are 7 lichen species which are included in the Red Book. The results of this study clearly indicate that the area should be recommended as a protected nature reserve in order to conserve these valuable lichen habitats.

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ADDITIONAL ABSTRACTS

(submitted after this abstract set print out)

Alaskan Portion of the Circumboreal Vegetation Map

M. Torre Jorgenson

Alaska Ecoscience, Fairbanks, AK, USA

Йоргенсон М.Т. Аляскинская часть карты циркумбореальной растительности

A map of boreal vegetation in Alaska is being developed as a contribution to the circumboreal vegetation mapping (CBVM) project. The effort included classification and mapping of six bioclimatic zones for boreal Alaska that provided the basis for classification of boreal vegetation. Vegetation mapping for Alaska is being done at 1:7.5 million scale using the protocol by the CBVM team. Mapping uses an integrated-terrain-unit approach that includes classifications for bioclimate, physiography, generalized geology, permafrost, disturbance, growth form, geographic sector, water coverage, and vegetation. Vegetation is mapped at five hierarchical levels: (1) formation type based on physiognomy and structure; (2) formation group differentiating zonal, extrazonal, and azonal systems; (3) formation based on dominant growth forms with finer subdivisions than Level 1; (4) bioclimatic subdivision based on temperature and precipitation indices; and (5) geographic sectors based on dominant species that characterize broad longitudinal regions or floristic provinces. The boreal vegetation classification for Alaska tentatively has 35 classes at Level 5. Nearly half of the mapping for Alaska has been completed and the remaining portion will be completed by the end of 2012. Future work will focus on integrating the classification, mapping, and GIS database into a North American map, and then with the other circumboreal regional efforts.

The use of specialist species and indicator species for delineation of key natural areas in spruce-fir forests of the Far East

Vyacheslav A. SPIRIN¹, Nadezhda S. LIKSAKOVA², Igor V. GLUSHKOV³

¹ *Botanical Museum of the University of Helsinki, Helsinki, Finland*

² *Komarov Botanical Institute RAS, Saint-Petersburg, Russia*

³ *Non-commercial partnership "Transparent World", Moscow, Russia*

Спирин В.А., Ликсакова Н.С., Глушков И.В. Использование характерных и индикаторных видов для выделения ключевых участков в елово-пихтовых лесах Дальнего Востока)

The delineation of key natural areas using specialist species and indicator species is well developed and widely used in Sweden, Finland, Latvia, Estonia and northwest Russia (Anderson et al. 2009) Key natural areas contain features not replicable in managed forest, and also contain rare forest communities or habitats. Such forests are inhabited by specialist species – species not adapted for survival in heavily disturbed forests, such as those experiencing industrial timber harvesting. The value of a forest tract for biodiversity conservation is also demonstrated by the presence of a complex of indicator species – species with relatively strict requirements to forest habitat conditions, but demonstrating somewhat greater ability to reproduce in forests disturbed by timber harvesting. In 2011 and 2012 we began work on the adaptation of this method to spruce-fir forests of the Far East. A number of large forest massifs in central Khabarovsk Krai were studied with the goal of developing a list of specialist and indicator species for that territory. The following main results were obtained: a preliminary list of specialist (23 species) and indicator species (40) of wood-destroying fungi was developed for the main spruce-fir forest types in a range of landscape positions. Some of these species were detected in Khabarovsk Krai for the first time, and on several occasions for the first time in the Russia. A number of these species were included in the “rare” category. The list of rare species comprises 13 species, although not one of them is included in the Red Books of the Russian Federation or Khabarovsk Krai. For other groups (vascular plants and lichens) a list of rare and protected species (12 species vascular plants and 14 lichen species) was established. Work on the development of the lists of specialist and indicator species continues. In the course of this research we delineated and described massifs of spruce-fir forests that, in our opinion, have heightened value for biodiversity conservation. The quantity of specialist and indicator species was compared between massifs.

