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Man-influenced vegetation of North Korea

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A b s t r a c t : New information on synanthropic vegetation at various man-influenced habitats in North Korea is given. Based on 70 phytocoenological relevés authors briefly characterized floristic composition and ecology of black locust forest, *Lycium chinense*-community, anthropogenous grasslands, wetland communities along riverbanks, and weed communities of crops. Similar communities from South Korea and Japan are compared. Penetration of some synanthropic species into various communities is documented and discussed.

Key words : vegetation classification, weed communities, man-depending vegetation, *Robinia pseudo-acacia* communities.

Introduction

Man-influenced vegetation of Korean Peninsula and Japan was studied only marginally in comparison with forest vegetation. More frequent are papers dealing with rice field vegetation (MIYAWAKI 1960, 1980-1989, SONG 1991, 1997, KOLBEK et al. 1996). Less frequent are studies aimed to vegetation of soya been fields (DOSTÁLEK et al. 1990), ruderal vegetation (MUCINA et al. 1991, KOLBEK et SÁDLO 1996, SÁDLO et KOLBEK 1997), vegetation of walls (KOLBEK et VALACHOVIČ 1996), artificial grasslands (ŠRÚTEK et KOLBEK 1992, BLAŽKOVÁ 1993), banks of rivers and basins (JAROLÍMEK et al. 1991, SONG et SONG 1996, SONG 2001, CHOUNG et LEE 2001), and water basins (KOLBEK et DOSTÁLEK 1996).

Several articles analysed secondary black locust-forests and influence of this species to natural vegetation (LEE 1997, MAEKAWA et NAKAGOSHI 1997, CHO et al. 1999, CHO et KIM 2005). Several studies dealt with complexes of city vegetation (MIYAWAKI 1972, 1973).

Within the study of North Korean vegetation in 1986-1990 authors of this article made also phytocoenological relevés in anthropogenous or man-influenced vegetation. Most of various types of this vegetation were published for the first time (see above). The rest of material with regard to its fragmentariness and difficulty of study was elaborated in this study. Except of stands with *Robinia pseudo-acacia* man influence to forest stands and plantations and used management was not studied before.

Materials and methods

70 phytocoenological relevés was analysed and synthesised using Braun-Blanquet approach (BRAUN-BLANQUET 1964). Authors used 9-degree version of Braun-Blanquet's scale modified by BARKMAN et al. (1964). Phytocoenological tables were arranged in programme FYTOPACK (JAROLÍMEK et SCHLOSSER 1997). The plant names follow Ri et HOANG (1984) and ANONYMOUS (1972-1976, 1979) except of *Solidago gigantea* AITON, *Anthriscus cerefolium* subsp. *trichosperma* (SCHULT.) ARCANG., *Anthriscus caucalis* M. BIEB., *Ballota nigra* L., and *Bromus sterilis* L. (not given in the List of North Korean plant species names). In relevés abbreviation JK means J. Kolbek (author of relevé).

Results and discussion

Black locust-forests

In the Korean Peninsula similarly than in whole Euro-Asia, the *Robinia pseudo-acacia* is introduced tree. It has become invasive species with various intensity of spreading in different vegetation regions. In the Korean Peninsula it is known mostly from south part, where it dominates in several woody communities (CHO et KIM 2005). It more and more frequently penetrates also into various very different plant communities. In the northern part of the Peninsula the occurrence of *Robinia pseudo-acacia* was investigated within complex vegetation study, more systematically in 1990.

In comparison with Central Europe (Germany, Czech Republic, Slovakia, Hungary, Romania) it occurs less frequently (VADAS 1914, GÖHRE 1952, ŠÁLY 1954, TUSKÓ 1956, KERESZTESI 1988). Well-developed stands are relatively rare and the species is not so aggressive. Whereas to the Europe it was introduced for the first time in years 1630-1638 and later massively in 19-th century, its introduction into the Korean Peninsula is probably later.

The herb layer of Central European stands dominated by *Robinia pseudo-acacia* (KOLBEK et al. 2004, VÍTKOVÁ et al. 2004) is composed by geophytes (species of genera *Allium*, *Gagea*, *Ornithogalum*, *Muscari*), nitrophytes (*Chaerophyllum temulum*, *Chelidonium majus*, *Anthriscus cerefolium* subsp. *trichosperma*, *A. caucalis*, *A. sylvestris*, *Agropyron repens*, *Ballota nigra*, *Galium aparine*, *Urtica dioica*), and grasses (*Bromus sterilis*, *Poa nemoralis*). In South Korean stands are frequent mostly *Commelina communis*, *Rosa multiflora*, *Quercus variabilis*, *Q. acutissima*, *Q. aliena*, *Oplismenus undulatifolius*; in North Korean stands with higher constancy were found *Agropyron tsukushiense* var. *transiens*, *Commelina communis*, *Erigeron annuus*, *Carex lanceolata*, *Chrysanthemum indicum*, *Diarrhena japonica*, *Humulus japonica* and others (see Tab. 1). *Chelidonium majus*, *Capsella bursa-pastoris*, *Carduus crispus*, *Calamagrostis arundinacea*, *Torilis japonica* and many other species are common in Korean and European stands.

From South Korea communities with *Robinia pseudo-acacia* were described by CHO et KIM (2005) based on 38 phytocoenological relevés comprising of 323 species of vascular plants. Relevés were classified to two communities: *Phragmites-Robinia pseudoacacia* community and ***Commelino-Robinietum pseudoacaciae*** CHO et KIM 2005. Authors of this association distinguished within the unit six subassociations: C.-R. typicum, C.-R.

quercetosum dentatae, C.-R. albizzietosum julibrissin, C.-R. pinetosum densiflorae, C.-R. quercetosum variabilis, and C.-R. ailanthetosum altissimae. Height of stands varies between 13 and 18 m, cover of tree layer varies between 60 and 95%, and cover of herb layer attains 25 to 100%.

CHO et al. (1999) pay attention to communities with *Robinia pseudo-acacia* and presented its occurrence in *Pinus densiflora*-, *Quercus acutissima*-, *Prunus leveilliana*-, *Sorbus alnifolia*-, *Zelkova serrata*-, *Fraxinus mandshurica*-, *Alnus japonica*-community, and in individual type *Robinia pseudo-acacia*-community. The last community is very similar (maybe identical) with the association Commelino-Robinetum by occurrence of several presented species (not all species are presented in synoptic table).

Nevertheless, stands of *Robinia pseudo-acacia* do not occupy small area. CHO et al. (1999) declared from Inwang Mts (Seoul) cover of *Robinia pseudo-acacia* plantations more than 86ha with 132 species. "*Robinia pseudo-acacia* plantation is widely distributed throughout this area, and mostly planted on the lower or middle parts of slope at lower elevation (150m) for erosion control" (CHO et al. 1999: 347). *Robinia pseudo-acacia* was found in South Korea generally at 174 from 200 localities investigated by YIM et JEON (1980).

In the comparison of actual and potential natural vegetation of Pukhansan National Park in South Korea, represented by natural oak forest of the *Acer pseudosieboldianum*-*Quercus mongolica* community with typical herb layer composition, LEE (1997) gives distribution of *Robinia pseudo-acacia* in the margin area of the Park with different floristic composition and synthesis from three plots with cover of *Robinia pseudo-acacia* 25-50%. *Robinia pseudo-acacia* penetrates into various types of this forest with low constancy and dominance. In note it is given that undergrowth of such stands is very poor. Pine forest mixed with *Robinia pseudo-acacia* the author classified as *Pinus densiflora*-*Robinia pseudoacacia* community.

Robinia pseudo-acacia is presented also as one of a tolerant species to air and soil pollution (YOU et al. 1998, cf. also VOGEL 1981).

SONG (2001) published occurrence of *Robinia pseudo-acacia* from communities Salicetum koreansio-chaenomeloides SONG et OHNO 2000 and Hemipteletum davidii SONG et OHNO 2000. This species was registered also in *Zelkova serrata*-community (SONG et SONG 1996).

From Japan, *Robinia pseudo-acacia* is known from the Islands Kyushu and Tohoku (MIYAWAKI et al. 1981: 289, tab. 91; 1987: 321) as "*Robinia pseudoacacia*-Forst". In one relevé, common species in comparison with Korean stands are presented only sporadically (*Rumex acetosa*). Floristic composition is not compatible with the association Commelino-Robinetum pseudoacaciae sensu CHO et KIM (2005) or other similar stands with *Robinia pseudoacacia* on the Korean Peninsula.

Robinia pseudo-acacia is distributed also in dune vegetation of Central Japan (MAEKAWA et NAKAGOSHI 1997). It is established there mainly in scrub zone with hard influence-effect on diversity of natural plant community.

Our following relevés from North Korea (Kumgang-san Mts) contain the most of differential species of the subassociation C.-R. pinetosum densiflorae. They occupy transitional position to the initial stands of community Artemisio feddei-Salicetum gracilistylae JAROLÍMEK et KOLBEK 2006 with species *Phragmites japonica*. *Robinia pseudo-acacia* attains only low values of cover in these relevés.

1. Kumgang-san, Onjong River, dry stony alluvium above the village Onjongri, relevé area 40 m², cover E₁: 85%, E₀: <1% indet., 27. June 1990, JK 155/90.

E₁: *Salix gracilistyla* 3, *Artemisia asiatica* 2, *Phragmites japonica* 2, *Rubus parvifolius* 2, *Spodiopogon sibiricus* 2, *Actinidia kolomicta* 1, *Artemisia feddei* 1, *Commelina communis* 1, *Agropyron *transiens* +, *Artemisia montana* +, *Erigeron canadensis* +, *Lespedeza bicolor* +, *L. maximowiczii* +, *Oenothera biennis* +, *Poa pratensis* +, ***Robinia pseudo-acacia*** +, *Rumex acetosella* +, *Securinega suffruticosa* +, *Stephanandra incisa* +, *Arenaria serpyllifolia* r, *Artemisia capillaris* r, *Myosoton aquaticum* r, *Viola mandshurica* r.

2. Kumgang-san, Onjong River, dry stony alluvium above the village Onjongri, relevé area 40 m², cover E₁: 85%, 27. June 1990, JK 156/90.

E₁: *Salix gracilistyla* 3, *Phragmites japonica* 2, *Rubus parvifolius* 2, *Solidago gigantea* 2, *Actinidia kolomicta* 1, *Agropyron *transiens* 1, *Forsythia ovata* 1, ***Robinia pseudo-acacia*** 1, *Spodiopogon sibiricus* 1, *Agrimonia pilosa* +, *Artemisia asiatica* +, *A. montana* +, *Commelina communis* +, *Fraxinus rhynchophylla* +, *Micromeles alnifolia* +, *Parthenocissus tricuspidata* +, *Poa pratensis* +, *Rosa multiflora* +, *Smilax sieboldii* +, *Staphylea bumalda* +, *Stephanandra incisa* +, *Weigela praecox* +, *Arthraxon hispidus* r, *Chylocalyx senticosus* r, *Humulus japonica* r, *Oenothera biennis* r, *Rubus crataegifolius* r, *Rumex acetosella* r, *Viola mandshurica* r.

3. Kumgang-san, Onjong River, dry stony alluvium above the village Onjongri, relevé area 100 m², cover E₂: 45%, E₁: 50%, 27. June 1990, JK 158/90.

E₂: ***Robinia pseudo-acacia*** 2, *Rosa multiflora* 2, *Salix gracilistyla* 2, *Spiraea japonica* 2, *Stephanandra incisa* 2, *Pinus densiflora* 1, *Weigela* sp. 1, *Callicarpa japonica* +, *Fraxinus rhynchophylla* +, *Lespedeza bicolor* +, *Palura paniculata* +, *Quercus mongolica* +, *Styrax obassia* +, *Vitis amurensis* +, *Acer pseudo-sieboldianum* r, *Clematis tubulosa* r, *Kalopanax pictum* r, *Lespeza maximowiczii* r, *Staphyllea bumalda* r, *Syringa venosa* r, *Tilia* sp. r;

E₁: *Spodiopogon sibiricus* 3, *Phragmites japonica* 2, *Carex lanceolata* 1, *Agropyron *transiens* +, *Artemisia asiatica* +, *Galium verum* +, *Isodon excisus* +, *Lysimachia *davurica* +, *Patrinia scabiosaefolia* +, *Artemisia capillaris* r, *A. feddei* r, *Commelina communis* r, *Chylocalyx senticosus* r, *Diarrhena japonica* r, *Dioscorea* sp. r, *Lepidium apetalum* r, *Oenothera biennis* r, *Pulsatilla koreana* r.

The next relevé represents arboreous locust tree stand. Regard to its small size and species poorness it cannot be ordered to any syntaxon.

4. Kumgang-san, Onjongri village, Onjong River, alluvium, relevé area 8 m², cover E₃: 60%, E₂: 15%, E₁: 65%, 9. June 1988, JK 94/88.

E₃: ***Robinia pseudo-acacia*** 4;

E₂: *Lycium chinense* 2;

E₁: *Saponaria officinalis* 3, *Leonurus sibiricus* 2, *Phragmites japonica* 1, ***Robinia pseudo-acacia*** 1, *Artemisia asiatica* +.

From North Korea (KOLBEK et SÁDLO 1996) *Robinia pseudo-acacia* is known as accompanying species of the alliance Cosmo-Humulion japonicae in the associations Daturu tatulae-Siegesbeckietum pubescentis KOLBEK et SÁDLO 1996 (constancy of 25%)

and *Humulo japonicae*-*Chenopodietum albi* KOLBEK et SÁDLO 1996 (7%). In the alliance *Plantaginion asiaticae* it occurs in the *Bryo-Saginetum japonicae* OHBA 1971 (31%) and in the alliance *Zoysion japonicae* in the *Digitario ciliaris-Zoysietum japonicae* BLAŽKOVÁ 1993 with only 4% of constancy (BLAŽKOVÁ 1993, SÁDLO et KOLBEK 1997, see also Tab. 3 in this article). In northern part of the Peninsula *Robinia pseudo-acacia* occurs also in the subassociation *Artemisio feddei-Salicetum gracilistylae* *spodiopogonetosum sibiricae* JAROLÍMEK et KOLBEK 2006 (10%) and in the successional juvenile, species-poor to species-rich stages of this association in the riverside vegetation (JAROLÍMEK et KOLBEK 2006). Sporadic occurrence of this species is known from the successional most developed stands of the association *Salsolo komarovii-Rosetum rugosae* KOLBEK et al. 1989 distributed along the North Korean coast of the Yellow Sea (KOLBEK et al. 1989).

Robinia pseudo-acacia is cultivated or invades into natural species-rich forests dominated by *Pinus densiflora* (see next example):

5. Pong-hari, monument near the river Taedong-gang, *Pinus densiflora*-forest beside the monument, calcareous slate outcrops visible on surface, relevé area 400 m², cover E₃: 70%, E₂: 50%, E₁: 50%, 15. June 1990, JAROLÍMEK 2103.

E₃: *Pinus densiflora* 4, ***Robinia pseudo-acacia* 2**, *Quercus mongolica* 1, *Celastrus flagellaris* +, *Morus alba* r;

E₂: *Securinega suffruticosa* 2a, *Zizyphus jujuba* 2a, *Corylus heterophylla* 1, *Euonymus alata* 1, *Prunus tomentosa* 1, *Fagaria schinifolia* +, *Gleditschia japonica* +, *Rhamnus koraiensis* +, *R. schneideri* +, *Rhus chinensis* +, *Ribes mandshuricum* +, *Spiraea trichocarpa* +, *Vitis amurensis* +;

E₁: *Spodiopogon sibiricus* 2a, *Artemisia messerschmidtiana* 1, *Calamagrostis arundinacea* 1, *Indigofera kirilowii* 1, *Isodon excisus* 1, *Lonicera thunbergii* 1, *Smilax sieboldii* 1, *Rubia cordifolia* 1, *Agrimonia pilosa* +, *Ampelopsis brevipedunculata* +, *Asparagus schoberioides* +, *Aster tataricus* +, *Calystegia davurica* +, *Carpesium cernuum* +, *Eupatorium* sp. +, *Fagaria schinifolia* +, *Hemerocallis coreana* +, *Juniperus rigida* +, *Lactuca bungeana* +, *Lespedeza tomentosa* +, *Menispermum dahuricum* +, *Polygonatum humile* +, *P. inflatum* +, *Prunus nakaii* +, *Rhus chinensis* +, *Rhynchosia volubilis* +, *Rubus parvifolius* +, *Sophora flavescens* +, *Syneilesis palmata* +, *Thalictrum baicalense* +, *Allium* sp. r, *Pueraria lobata* r, *Quercus dentata* juv. r.

Six phytocoenological relevés of *Commelino-Robinetum* from North Korea (Tab. 1) were made at habitats of original forests dominated by *Quercus mongolica*, *Q. acutissima* and *Pinus densiflora* on loamy soils. Excepted age of stands is approximately 30-50 years. These stands well correspond with this association by their floristic composition; small number of relevés do not allow their classification into lower level of subassociations. Slight similarity to the subassociation C.-R. *pinetosum densiflorae* is indicated by presence of species *Pinus densiflora*, *Spodiopogon sibiricus* and *Erigeron annuus*. North Korean black locust-tree forests represent secondary forests alternating original oak forests.

Phytocoenological relevés of the *Commelino-Robinetum* from North Korea are relatively homogenous due to low number of samples and localities. 21 species are characterised with constancy 50% and more. The group of accessory species with low constancy (presented in one relevé) is very high and contents 38 taxa. High number of these acces-

sory plants in the stands of *Robinia pseudo-acacia* in Euro-Asia is typical feature of such forests.

Lycium chinense-community

Artificial **stands of the shrub *Lycium chinense*** are typical for margins of some gardens and public parks in villages and cities. More natural stands occur in complexes of river-side vegetation. Their floristic composition is weakly known only from South Korea from two relevés published by SONG et SONG (1996) and SONG (2001). The riverside stands are species poor with simple structure in shrub layer and several herbs in undergrowth.

Artificial shrubs of *Lycium chinense* in North Korea are more species rich (Tab. 2). Most of species are weeds penetrating into shrubs from surrounding ruderal and segetal vegetation. Generally, only *Humulus japonica* and *Cocculus trilobus* are common species in natural and artificial stands. Occurrence of these species from this territory is also known from the association *Daturo tatulae-Siegesbeckietum pubescentis* KOLBEK et ŠADLO 1996 (the alliance *Cosmo-Humulion japonicae*). Seedlings of *Lycium chinense* occur in this association with frequency 25%.

One relevé with occurrence of *Lycium chinense* is located also at the riverside of river in Kumgang-san Mts in North Korea. *Robinia pseudo-acacia* dominates in tree layer (see rel. 4 in the text).

Artificial stands are regularly cut. They are not hoed and weeded and give suitable space for ecession of synanthropic species and species of open habitats. These species are helio- and nitrophilous and grow usually at disturbed soils.

Artificial grasslands dominated by *Zoysia japonica*

In North Korea *Zoysia japonica* builds stands at artificial lawns with relative strong management, which is based beside the planting of *Zoysia japonica* also on regular weeding and removing of some unsuitable species (ŠRÚTEK et KOLBEK 1992). Such lawns in cities and villages are of relatively homogenous structure and their species composition is minimised to low number of present species. Beside these artificial stands it is possible to find semi-natural stands recalling pastures or less mowed meadows. Similar stands are described in literature very scarcely and their syntaxonomical classification is problematic. Phytocoenological study of these and several similar stands published BLAŽKOVÁ (1993). Based on 23 relevés from North Korea she distinguished association ***Digitario ciliaris-Zoysietum japonicae*** BLAŽKOVÁ 1993 with three subassociations: D. c.-Z. j. cyperetosum microiriae, D. c.-Z. j. eragrostietosum ferrugineae and D. c.-Z. j. ixeridetosum dentatae.

Set of our 21 relevés (Tab. 3) is closely related to this association, but not to any described subassociation. In spite of various locations, stands are relatively homogenous and contain numerous association species, such as *Zoysia japonica*, *Viola mandshurica*, *Erigeron canadensis* and *Cassia nomame*. Stands lack important and name-giving species – *Digitaria ciliaris*. High constancy of *Ixeris dentata* indicates subassociation D. c.-Z. j. ixeridetosum dentatae, which is in original diagnosis differentiated by this only species. Unambiguous classification into this subassociation is not possible due to presence of high number of species of trampled habitats (*Poa pratensis*, *Taraxacum officinalis* agg., *Plantago asiatica*) concentrated in the association *Plantagini asiaticae*-

Poetum pratensis BLAŽKOVÁ 1993. It is possible, that our set of relevé represents different unit, but correct classification of these man hardly influenced grasslands needs more data from larger territory, which is out of frame of this study.

Zoysia japonica occurs also in other trampled communities in North Korea (MUCINA et al. 1991): in the alliance *Chenopodio ficifolii*-*Plantaginion depressae* (in associations *Plantagini depressae*-*Polygonetum avicularis* MUCINA et al. 1991 and *Plantagini depressae*-*Potentilletum costatae* MUCINA et al. 1991). In these syntaxa it attains cover 3 and high constancy. With low constancy it is presented also in associations *Euphorbio maculatae*-*Centipedetum minimae* MUCINA et al. 1991 and *Setario viridis*-*Chlorisetum virgatae* MUCINA et al. 1991.

SÁDLO et KOLBEK (1997) registered occurrence of *Zoysia japonica* in several communities with various constancy: *Aeschynomeno indicae*-*Kummerowietum striatae* JAROLÍMEK et al. 1991 (11%), *Plantagini depressae*-*Polygonetum avicularis* (52%), *Setario viridis*-*Chlorisetum virgatae* (10%), *Plantagini asiaticae*-*Poetum pratensis* (7%), and *Digitario ciliaris*-*Zoysietum japonicae* (96%).

Anthropical grasslands

Regionally limited phytocoenological data set represents two groups of communities. Both are classified within the association ***Plantagini asiaticae*-*Poetum pratensis*** BLAŽKOVÁ 1993 (Tab. 4). As typical we regard relevés 4-7 containing most of diagnostic taxa of the association. In harmony with description of this syntaxon *Poa pratensis*, *P. annua* and *Polygonum aviculare* are dominant species; *Plantago asiatica* attains higher constancy. In relevés 1-3 (Tab. 4) species *Poa pratensis* absents. They can be regarded as younger succession stadium of this community. High dominance of *Liriope platyphylla* is supported by deliberate cultivation of this species in city parks and lawns. Relevés in table 4 fill up information on this unit, which was known from North Korea only by 7 relevés. They characterise new macro-locality of this community (Hedju), known until now from Pyongyang, Kaesong, Kungang Spa and Wonsan. Synthetic table of this community was published in SÁDLO et KOLBEK (1997) together with other terrestrial ruderal communities.

Pioneer plant communities at gravel and sand river alluvium

Pioneer communities at gravel and sand river alluvia along not controlled rivers are exposed to quick dynamic of changes. They are the suitable model for study of succession processes. On the other hand, they are hardly classifiable. They are typical by various age in time series and big differences in cover, which can change during short time. They change also in vegetation seasons. They are most influenced by dynamic of flow and flow volume. Their arising and destruction depends on actual situation. The main reason for description of these communities is not necessary their syntaxonomical classification, but description of species composition in harmony with ecological circumstances of environment. In the next text only samples of these communities found and registered in the field are demonstrated.

Relevés 1 and 2 in table 5 represent **initial stadium** of succession at sand-gravel alluvium of the river in Myohyangsan-Mts. High speed flow of river and big fluctuation of water level depending on rainfalls keeps this community in initial phase. Cover of herb layer is slender. *Phragmites japonica* only resists against destruction flow of river thanks

to several meters long shoots. Occurrence of other herbs is occasional and depends on import of diaspores from surrounding vegetation cover.

Relevés 3-5 represent **more stable type of vegetation** with regular occurrence of some species, including woody plant. If they are successful, they create mantel communities during several years. Cover of vegetation is relative higher (15-30%). Up-and-down surface of sandy-gravel alluvium form different ecological conditions supporting development of micro-populations of some species.

At deeper and more stable sands less frequently affected by water flow, the **community with *Carex pumila*** rises (rels 6-7). This community has more stable structure, it is identifiable in the fields and due to these properties it is more frequently described in literature. From northern part of Korean Peninsula it was mentioned by MUCINA et DOSTÁLEK (1985) at sea sand dunes near Wonsan. From South Korea this community enriched by species *Salsola komarovii*, *Typha angustifolia* and *Chenopodium glaucum* described MIN et KIM (1999). With name *Caricetum pumilae* sensu IHM, LEE et KIM 2001 from the class *Glehnieta* it was published by IHM et al. (2001).

MIYAWAKI (1981, 1982, 1983, 1988) found community with *Carex pumila* in islands Kyushu, Shikoku, Chugoku and Hokkaido. This community contains species typical for sea sand dunes (*Carex kobomugi*, *Calystegia soldanella*, *Glehnia littoralis*). Species composition is similar to stands growing in Korean sea-cost (see MUCINA et DOSTÁLEK 1985). Stands along riverbanks at sand alluvia are different by absence of sea-cost species.

In next succession willow shrubs replace this community. Nevertheless, *Carex pumila* together with several species, such as *Commelina communis*, *Humulus japonica*, *Lepidium apetalum*, *Rumex acetosella* and *Equisetum arvense*, persist in stand for several years – see *Artemisio-Salicetum gracilistylae artemisietosum capillaris* (JAROLÍMEK et KOLBEK 2006: tab. 1, rel. 6 and 12).

Relevés 8 and 9 (Tab. 5) represent near closed stands (cover up to 95%) corresponding by their character and habitat to European **meadow phytocoenoses**. They are grass stands supplied by numerous herbs (*Sanguisorba officinalis*, *Taraxacum officinalis* agg., *Glechoma hederacea*, *Calamagrostis epigeios*, *Agrostis alba*, *Equisetum arvense*, *Trifolium repens*) including high ferns (*Onoclea sensibilis*). Such stands are rare and survive for a longer time only by cutting or by pasture. This type of management is in Korea exceptional. In literature they are described only scarcely (SONG et SONG 1996, SONG 2001).

Moister type of grass-herbaceous riverbank communities is represented by relevé with dominant species ***Lobelia chinensis*** and several taxa of fresh and not-drying soils, such as *Juncus decipiens*, *Oenanthe decumbens*, *Stellaria alsine*, and *Bidens frondosa*. *Lobelia chinensis* occurs also in community with *Scirpus triquetus* (Tab. 6, rel. 6).

6. Kumgang-san, on the banks of the river Namgang near the village Samilpori, relevé area 16 m², cover E₁: 90%, 30. June 1990, JK 207/90.

E₁: ***Lobelia chinensis*** 3, *Viola verecunda* 3, *Calamagrostis epigeios* 2, *Persicaria thunbergii* 2, *Artemisia selengensis* 1, *Oenanthe decumbens* 1, *Oxalis stricta* 1, *Stellaria alsine* 1, *Bidens frondosa* +, *Juncus decipiens* +, *Persicaria sieboldii* +, *Prunella asiatica* +, *Trifolium repens* +, *Taraxacum officinalis* agg. r.

Plant communities of shallow periodically flooded terrain depressions

Sand riverbanks in Kungang-san Mts are covered by **vegetation of sand dunes** (Tab. 5). In depressions of dunes vegetation depending on the level of underground water is concentrated. In some places water increases above the soil surface and forms inundate depressions with depth of water from several centimetres to several decimetres. In course of vegetation period depth of water oscillates, the deepest water is usually during summer monsoon. If the depressions are sufficiently deep, they are grown by representatives of the genus *Potamogeton* (Tab. 6, rel. 1), which are able to accept oscillating water level (*Potamogeton vaseyi*, *P. distinctus*). The last mentioned species occurs also in stands with dominating *Nelumbo nucifera* in artificial basins with moody bottom (KOLBEK et DOSTÁLEK 1996: Tab. 3).

Relevés 2-7 (Tab. 6) form community with dominating *Scirpus triqueter*. This is species of wide ecological valence. It occurs at rice fields in the association Sagittario-Monochorietum MIYAWAKI 1960 in North Korea (KOLBEK et al. 1996) and also in salt marsh vegetation at sea-cost of Yellow Sea: Triglochini maritimae-Phragmitetum communis KOLBEK et al. 1989 and Artemisietum fukudo MIYAWAKI et OHBA 1969 (KOLBEK et al. 1989). Scarcely this species was found in association Polygonetum thunbergii LOHMEYER et MIYAWAKI 1962 and *Persicaria dissitiflora* community (JAROLÍMEK et al. 1991). MIYAWAKI (1984: 212) has gave *Scirpus triqueter* from the riverbank of Takeda River (Insel Kinki) as dominant of species poor community containing four species only.

In the relevé 8 (Tab. 6) *Scirpus radicans* dominates, in relevés 9-10 *Scirpus yagara* prevails. Other species composition is nearly identical. In relevé 11 dominant species are *Scirpus preslii* and representatives of the genus *Eleocharis*. In the North Korea *Scirpus preslii* occurs also in association Sagittario-Monochorietum MIYAWAKI 1960 at rice fields. It is differential species of the subassociation S.-M. sagittarietosum aginashi KOLBEK et al. 1996.

The last relevé (rel. 12, Tab. 6) shows floristic composition of vegetation of shallow periodical depressions grown by species *Alisma orientalis*. This stand is similar to analogous habitats in Central Europe, which are overgrown by *Alisma plantago-aquatica*-community.

Weed communities of crops

Korean phytocoenological works dealing with weed communities at arable lands are concentrated to weed vegetation of rice fields (SONG 1991, 1997, KOLBEK et al. 1996), soya-been fields (DOSTÁLEK et al. 1990), or abandoned fields of these types of cultures. Weed vegetation of other types of cultures was not systematically studied.

Plantation of crops used in cooking is relatively more frequent. Following two relevés, from Myohyang-san Mts and Kungang-san Mts, show floristic composition of weed vegetation of fields with **cultivated crop *Platycodon grandiflorus***. Its tuber-roots are used for preparing of tasteful salad. Both stands contain numerous common species (*Oxalis corniculata*, *Chenopodium album*, *Erigeron annuus*, *Siegesbeckia pubescens*, *Artemisia asiatica*, *Myosoton aquaticum*, *Portulaca oleracea*, *Viola mandshurica*).

7. Myohyang-san, Hyangsan city, near the hotel, *Platycodon* field, relevé area 20 m², cover E₁: 75%, E₀: 10% indet., 19. June 1990, JK 85/90.

E₁: *Platycodon grandiflorus* 4, *Oxalis corniculata* 2, *Centipeda minima* 1, *Chenopodium*

album 1, *Convolvulus arvensis* 1, *Senecio vulgaris* 1, *Setaria viridis* 1, *Acalypha australis* +, *Chenopodium glaucum* +, *Chylocalyx perfoliatus* +, *Digitaria sanguinalis* +, *Erigeron annuus* +, *E. canadensis* +, *Euphorbia maculata* +, *Kochia scoparia* +, *Mazus japonicus* +, *Myosotis laxa* +, *Rorippa palustris* +, *Siegesbeckia pubescens* +, *Zoysia japonica* +, *Artemisia asiatica* r, *A. capillaris* r, *Capsella bursa-pastoris* r, *Cassia nomame* r, *Geum aleppicum* r, *Lepidium apetalum* r, *Myosoton aquaticum* r, *Portulaca oleracea* r, *Sagina japonica* r, *Viola mandshurica* r.

8. Kumgang-san, Onjongri village, *Platycodon* field, relevé area 25 m², cover E₁: 80%, E₀ absent, 21. June 1990, JK 98/90.

E₁: ***Platycodon grandiflorus* 3**, *Setaria viridis* 3, *Phaseolus vulgaris* 2, *Arenaria serpyllifolia* 1, *Aster scaber* 1, *Chenopodium album* 1, *Erigeron annuus* 1, *E. canadensis* 1, *Geranium sibiricum* 1, *Portulaca oleracea* 1, *Siegesbeckia pubescens* 1, *Orthodon punctatum* 1, *Artemisia asiatica* +, *Arthraxon hispidus* +, *Cassia nomame* +, *Chelidonium majus* +, *Commelina communis* +, *Duchesnea indica* +, *Humulus japonica* +, *Myosoton aquaticum* +, *Oxalis corniculata* +, *Persicaria alata* +, *P. mitis* +, *Sedum sarmentosum* +, *Trifolium repens* +, *Veronica arvensis* +, *Viola mandshurica* +, *Paraixeris denticulata* r, *Taraxacum officinalis* agg. r.

In Korea growing grain is rare and grain fields in higher elevations occur rather exceptionally. Their species composition (according to only relevé from rye field) is very similar to previous field cultures and they have numerous common species. We expect that in this region floristic composition of weed vegetation of terrestrial field cultures is not seriously influenced by cultivated crop, but more by management.

9. Kumgang-san, Valley of the river Guriong-tschon, sand soil, relevé area 50 m², cover E₁: 60%, E₀ absent, 23. June 1990, JK 124/90.

E₁: ***Secale cereale* 3**, *Rumex acetosella* 3, *Setaria glauca* 2, *Persicaria mitis* 1, *Cassia nomame* 1, *Commelina communis* 1, *Arenaria serpyllifolia* +, *Artemisia asiatica* +, *A. capillaris* +, *A. japonica* +, *Arthraxon hispidus* +, *Erigeron canadensis* +, *Kummerowia striata* +, *Oenothera biennis* +, *Phaseolus vulgaris* +, *Plantago depressa* r.

Conclusions

Knowledge on man-influenced and anthropogenous vegetation from North Korea (and in South Korea also) is limited and insufficient. In only several works authors describe and try to classify North Korean segetal and ruderal vegetation (see Introduction). Similarly management of using and exploitation of country is published very scarcely. Beside the article in Czech language published in popularly scientific journal (SÁDLO et KOLBEK 2006) there are no comprehensively elaborated basic documents on this topic, even though exploitation of landscape is very intensive and due to geographical distance and cultural tradition it is hardly comparable with landscape management in Europe.

In North Korean landscape meadows, pastures and cereal fields are rare elements. In alluviums rice fields dominate, in higher elevations vegetable fields prevail. Woodlands in mountains are managed mostly by preferential approach. *Pinus densiflora* plantations represent forests in city circumstance. System man-crop-weed is more closed than in

Central Europe. In consequence of real manual interference to agrocoenoses, some typical European landscape features are (nearly) missing:

- 1) Fine-grain landscape pattern,
- 2) Miscellaneous mosaic of meadows, various fields and woodlands,
- 3) Shrubby hillsides, shrubby field balks and small groves surrounded by meadows and fields.

Close adjacency of places with different man influence is flagrant on many localities (field versus natural forest). Whereas in Central European country large areas of introduced woods are usual, in Korea these types of forest are rare. Exceptional occurrence of *Robinia pseudo-acacia* forests in comparison with other forest types is in harmony with this fact.

Very carefully cultivated and weeded artificial lawns are typical feature of city landscape. They are dominated by *Zoysia japonica*, which is planted (not sown). By intensive management they are slightly similar to "English lawns".

Knowledge on North Korean man-influenced vegetation based on present study and known from several publications are certainly not comprehensive. They are rather torso and first attention to vegetation types of cultural landscape of this country.

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Zusammenfassung

Aufgrund 70 phytozöologischen Aufnahmen ist die Vegetation der synanthropisch beeinflussten Standorten in Nord Korea bearbeitet. Die floristische Zusammensetzung und Ökologie sind in den Beständen von *Robinia pseudo-acacia*-Wäldern, *Lycium chinense*-Kräutern, anthropogenen Grassländern, in der Vegetation der nassen Flusssorten und in der Unkrautvegetation der Felder angeführt. Die Gesellschaften sind mit der bisher bekannten südkoreanischen und japanischen Literatur verglichen. Die Durchdringungen der einigen synanthropen Arten in die verschiedenen Pflanzengesellschaften sind dokumentiert und diskutiert. Alle behandelten Einheiten sind zum erstenmal für Nord Korea angegeben.

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Appendix

Tab. 1. Commelino communis-Robinetum pseudoacaciae.

Number of relevé	1	2	3	4	5	6	%
Exposition	SE	SE	W	W	E	S	
Slope (°)	25	20	25	15	20	15	
Relevé area (m ²)	100	200	250	150	100	100	
Cover of tree layer (%)	80	70	80	70	65	70	
Cover of shrub layer (%)	50	75	25	20	70	70	
Cover of herb layer (%)	80	60	80	80	35	20	
E ₃							
<i>Robinia pseudo-acacia</i>	5	4	5	4	4	4	100
<i>Quercus acutissima</i>	.	.	.	.	1	a	33
E ₂							
<i>Robinia pseudo-acacia</i>	3	4	a	a	4	4	100
<i>Spiraea prunifolia</i>	+	+	.	.	.	.	33
<i>Prunus triloba</i>	r	.	.	+	.	.	33
<i>Fagaria schinifolia</i>	.	.	+	r	.	.	33
<i>Quercus acutissima</i>	.	.	.	+	.	+	33
<i>Euonymus alata</i>	.	.	.	.	+	+	33
<i>Quercus dentata</i>	.	.	.	.	r	+	33
E ₁							
<i>Agropyron *transiens</i>	a	a	1	1	r	+	100
<i>Commelina communis</i>	a	1	1	+	1	+	100
<i>Erigeron annuus</i>	+	+	a	a	1	+	100
<i>Carex lanceolata</i>	+	+	a	1	1	a	100
<i>Persicaria mitis</i>	a	1	.	r	a	r	83
<i>Humulus japonica</i>	+	1	.	+	a	+	83
<i>Rubus parvifolius</i>	.	+	1	+	+	1	83
<i>Cleistogenes hackelii</i>	a	a	.	1	.	1	67
<i>Chenopodium album</i>	a	a	.	.	a	r	67
<i>Robinia pseudo-acacia</i>	a	.	.	1	1	+	67
<i>Viola mandshurica</i>	+	1	.	r	.	+	67
<i>Chelidonium majus</i>	+	+	1	.	+	.	67
<i>Lactuca raddeana</i>	+	+	.	+	.	+	67
<i>Carduus crispus</i>	r	r	1	1	.	.	67
<i>Diarrhena japonica</i>	.	.	3	4	a	a	67
<i>Chrysanthemum indicum</i>	.	.	a	a	a	1	67
<i>Capsella bursa-pastoris</i>	1	+	.	+	.	.	50
<i>Leonurus sibiricus</i>	+	1	.	1	.	.	50
<i>Ambrosia artemisiifolia</i>	+	+	.	.	r	.	50
<i>Rubus crataegifolius</i>	.	.	a	a	.	+	50
<i>Agrimonia pilosa</i>	.	.	+	+	.	+	50
<i>Calamagrostis arundinacea</i>	.	.	.	r	1	+	50
<i>Melica turczaninowiana</i>	a	a	.	.	.	.	33
<i>Galium aparine</i>	a	1	.	.	.	.	33
<i>Carex</i> sp.	+	+	.	.	.	.	33
<i>Hemistepta lyrata</i>	+	+	.	.	.	.	33

<i>Ixeris polycephala</i>	+	+	.	.	.	.	33
<i>Lactuca bungeana</i>	+	.	.	+	.	.	33
<i>Spiraea prunifolia</i>	.	+	1	.	.	.	33
<i>Oenothera cf. biennis</i>	.	+	.	1	.	.	33
<i>Erigeron canadensis</i>	.	r	.	r	.	.	33
<i>Torilis japonica</i>	.	.	a	r	.	.	33
<i>Dontostemon dentatus</i>	.	.	1	+	.	.	33
<i>Potentilla fragarioides</i>	.	.	1	+	.	.	33
<i>Carpesium</i> sp.	.	.	+	+	.	.	33
<i>Pinus koraiensis</i> [cultivated]	.	.	+	+	.	.	33
<i>Lactuca indica</i>	.	.	+	r	.	.	33
<i>Euonymus alata</i>	.	.	+	.	r	.	33
<i>Duchesnea indica</i>	.	.	+	.	.	r	33
<i>Fagara schinifolia</i>	.	.	+	.	.	r	33
<i>Oxalis stricta</i>	.	.	.	+	.	+	33
<i>Poa compressa</i>	.	.	.	+	.	r	33
<i>Chylocalyx perfoliatus</i>	.	.	.	.	+	r	33

In one relevé:

E₂ – *Actinidia kolomicta* 6: r, *Forsythia* sp. 1: a, *Hemiptelea davidii* 6: +, *Lonicera caerulea* 2: +, *Morus alba* 5: 1, *Parthenocissus tricuspidata* 5: +, *Pinus densiflora* 3: 1, *Prunus padus* 6: 1, *Prunus persica* 6: a;

E₁ – *Actinidia kolomicta* 3: +, *Artemisia asiatica* 2: +, *A. capillaris* 4: r, *Asparagus oligoclonus* 3: r, *Aster scaber* 3: 1, *Celtis* sp. 6: r, *Cerastium caespitosum* 3: +, *Chenopodium ficifolium* 2: r, *Chylocalyx senticosus* 3: +, *Cirsium maackii* 3: +, *Cucurbita* sp. 6: +, *Dianthus chinensis* 4: r, *Dioscorea tokoro* 6: +, *Draba* cf. *nemorosa* 1: r, *Dryopteris austriaca* 5: r, *Forsythia* sp. 2: +, *Galium verum* var. *asiaticum* 3: +, *Hemiptelea davidii* 3: +, *Iris rossi* 3: +, *Juniperus rigida* 3: +, *Lonicera japonica* 6: +, *Morus alba* 6: +, *Myosoton aquaticum* 1: +, *Orthodon* cf. *punctatum* 4: r, *Phryma leptostachya* 3: +, *Pilea hamaoi* 5: r, *Pinus densiflora* 3: +, *Plantago depressa* 3: r, *Poa nemoralis* 3: 1, *Quercus acutissima* 6: r, *Q. dentata* 5: +, *Ranunculus japonicus* 3: +, *Rubia cordifolia* 1: +, *Spodiopogon sibiricus* 6: r, *Taraxacum officinalis* agg. 2: +, *Thlaspi arvense* 4: +, *Viola hirtipes* 4: r.

Localities of relevés:

1-2: Pyongyang, *Robinia*-forest near the hotel Ryanggansan, 12. 6. 1990, JK 6, 5/90; **3-4:** Dzungghoa, near the village, ca 25km from Pyongyang to Hedju, 8. 7. 1990, JK 295-296/90; **5-6:** Pyongyang, *Robinia*-forest near the hotel Ryanggansan, 8. 7. 1990, JK 298-299/90.

Tab. 2. *Lycium chinense*-community.

Number of relevé	1	2	3	4	5	6	%
Exposition	-	-	-	SW	SW	SW	
Slope (°)	0	0	0	10	10	10	
Relevé area (m ²)	40	30	40	30	30	30	
Cover of shrub layer (%)	80	75	80	100	100	100	
Cover of herb layer (%)	20	35	40	20	10	20	
E₂							
<i>Lycium chinense</i>	5	5	4	5	5	5	100
<i>Ailanthus altissima</i>	+	.	.	.	1	a	50
<i>Ligustrum ovalifolium</i>	.	1	+	.	.	.	33
<i>Diospyros lotus</i>	.	.	a	.	a	.	33
<i>Acer negundo</i>	.	.	.	.	1	a	33
E₁							
<i>Chenopodium album</i>	1	+	+	a	1	1	100
<i>Erigeron canadensis</i>	+	+	+	1	+	+	100
<i>Commelina communis</i>	1	.	r	a	1	a	83
<i>Artemisia asiatica</i>	1	a	a	+	.	.	67
<i>Humulus japonica</i>	a	.	.	.	a	a	50
<i>Orthodon punctatum</i>	+	r	r	.	.	.	50
<i>Erigeron annuus</i>	r	1	1	.	.	.	50
<i>Agropyron *transiens</i>	.	1	+	a	.	.	50
<i>Siegesbeckia pubescens</i>	.	.	.	r	+	+	50
<i>Kochia scoparia</i>	+	.	.	1	.	.	33
<i>Plantago asiatica</i>	r	.	+	.	.	.	33
<i>Bidens tripartita</i>	r	.	.	r	.	.	33
<i>Chelidonium majus</i>	.	a	a	.	.	.	33
<i>Poa pratensis</i>	.	1	+	.	.	.	33
<i>Lepidium apetalum</i>	.	r	r	.	.	.	33
<i>Ricinus communis</i>	.	r	.	.	r	.	33
<i>Senecio vulgaris</i>	.	.	.	+	+	.	33
<i>Setaria viridis</i>	.	.	.	+	.	+	33
<i>Xanthium strumarium</i>	.	.	.	.	+	1	33
<i>Chenopodium serotinum</i>	.	.	.	.	r	r	33

In one relevé:

E₂ – *Akebia quinata* 6: a, *Clematis tubulosa* 6: 1, *Clerodendron trichotomum* 6: +, *Cocculus trilobus* 6: 1, *Ginkgo biloba* 4: 1, *Morus alba* 5: 1, *Parthenocissus tricuspidata* 5: +, *Salix babylonica* 5: a;

E₁ – *Arenaria serpyllifolia* 1: r, *Artemisia capillaris* 1: r, *A. feddei* 3: +, *Bidens bipinnata* 6: r, *Cannabis sativa* 3: r, *Capsella bursa-pastoris* 3: r, *Chylocalyx senticosus* 3: 1, *Coriandrum sativum* 4: r, *Fagopyrum tataricum* 1: r, *Leonurus sibiricus* 3: r, *Menispermum dahuricum* 6: 1, *Myosoton aquaticum* 2: +, *Oenothera biennis* 3: r, *Oxalis corniculata* 1: r, *Perilla frutescens* 4: r, *Persicaria cochinchinensis* 6: +, *P. nepalensis* 3: r, *P. thunbergii* 3: +, *Pharbitis nil* 5: r, *Phaseolus coccineus* 4: 1, *Phragmites japonica* 3: 1, *Platycodon grandiflorus* 1: r, *Poa annua* 1: +, *P. trivialis* 1: +, *Rubus parvifolius* 6: 1, *Rumex acetosella* 2: +, *Setaria glauca* 1: 1, *Stellaria media* 1: r, *Tradescantia reflexa* 1: +, *Trigonotis peduncularis* 3: r.

Localities of relevés:

1-3: Kumgang-san Mts, in the village Onjongri, 27. 6. 1990, JK 164-166/90; **4-6:** Hedju, in the city, 7. 7. 1990, JK 289-291/90.

[illegible]

[illegible]

E₁ – *Alopecurus geniculatus* 5: +, *Amorpha fruticosa* 19: +, *Artemisia feddei* 19: r, *Cannabis sativa* 2: r, *Cardamine flexuosa* 4: r, *Carex pumila* 18: 1, *Coreopsis lanceolata* 19: r, *Descurainia sophia* 7: r, *Diarrhron linifolium* 7: +, *Digitaria sanguinalis* 6: +, *Duchesnea indica* 13: r, *Erigeron acris* 3: +, *Galium verum* var. *asiaticum* 2: +, *Humulus japonica* 21: r, *Iris* sp. 17: +, *Lactuca bungeana* 4: r, *Lathyrus* sp. 6: r, *Leonurus sibiricus* 6: r, *Liriope platyphylla* 4: +, *Lysimachia barystachys* 21: r, *Medicago lupulina* 6: +, *Orthodon punctatum* 21: r, *Oxalis stricta* 4: r, *Paraixeris denticulata* 5: 1, *Phtheirospermum japonicum* 12: +, *Pinus densiflora* 20: r, *Poa annua* 5: +, *Polygonum aviculare* 7: r, *Prunella asiatica* 2: +, *Prunus* sp. 20: r, *Rubus parvifolius* 18: r, *Sagina japonica* 5: a, *Saponaria officinalis* 14: +, *Scilla scilloides* 12: +, *Senecio flammeus* 21: 1, *Solidago japonica* 17: r, *Stellaria alsine* 9: r, *Themedra japonica* 7: +, *Torilis japonica* 4: r, *Vincetoxicum* sp. 21: r, *Viola hirtipes* 8: r.

1-2: Pyongyang, lawn near the airport, 11. 6. 1990, JK 1-2/90; **3-4:** Pyongyang, lawn near the hotel Ryanggansan, 11. 6. 1990, JK 3-4/90; **5-6:** Mangende, lawn in the village, 10 km W of Pyongyang, 13. 6. 1990, JK 16-17/90; **7:** Pyongyang, lawn near the football stadium, 13. 6. 1990, JK 20/90; **8-10:** Myohyang-san Mts, lawn near the hotel in the city Hyangsan, 19. 6. 1990, JK 82-84/90; **11-13:** Kungang-san Mts, lawn near the hotel in the village Onjongri, 21. 6. 1990, JK 101-103/90; **14-16:** Kungang-san Mts, lawn on the stream bank in the village Onjongri, 30. 6. 1990, JK 225-227/90; **17-20:** Kungang-san Mts, lawn on the right bank of the stream in the village Onjongri, 1. 7. 1990, JK and J. Sádlo, 236-239/90; **21:** Dzaeryong, near the village, cca 120 km from Pyongyang to Huedu, 8. 7. 1990, JK 297/90.

Tab. 4. Anthropogenic grasslands of *Plantagini asiaticae*-*Poetum pratensis*: without *Poa pratensis* (rels 1-3) and typical (rels 4-7).

Number of relevé	1	2	3	4	5	6	7
Exposition	-	N	-	-	-	-	-
Slope (°)	0	10	0	0	0	0	0
Relevé area (m ²)	4	30	15	10	10	10	10
Cover of herb layer (%)	65	90	80	80	90	80	85
Cover of moos layer (%)	0	0	0	1	0	0	0
<hr/>							
E ₁							
<i>Polygonum aviculare</i>	+	r	+	+	3	a	a
<i>Poa annua</i>	3	4	a	3	3	.	+
<i>Plantago asiatica</i>	+	a	.	.	+	.	+
<i>Poa pratensis</i>	.	.	.	3	a	4	4
<i>Erigeron canadensis</i>	a	+	.	+	.	.	.
<i>Rorippa atrovirens</i>	a	r	.	+	.	.	.
<i>Oxalis corniculata</i>	+	.	l	+	.	.	.
<i>Senecio vulgaris</i>	+	.	r	.	.	r	.
<i>Artemisia asiatica</i>	.	l	.	r	+	.	.
<i>Paspalum thunbergii</i>	.	r	.	l	+	.	.
<i>Viola mandshurica</i>	l	.	.	r	.	.	.
<i>Chenopodium album</i>	.	+	.	+	.	.	.
<i>Liriope platyphylla</i>	.	.	4	l	.	.	.
<i>Solanum nigrum</i>	.	.	r	r	.	.	.
<i>Digitaria ischaemum</i>	.	.	.	.	a	.	r
<i>Xanthium strumarium</i>	.	.	.	.	l	r	.
<i>Capsella bursa-pastoris</i>	.	.	.	.	+	+	.
<i>Kochia scoparia</i>	.	.	.	.	.	r	r

In one relevé:

E₁ – *Acalypha australis* 3: r, *Agropyron *transiens* 2: +, *Centipeda minima* 1: +, *Clematis tubulosa* 2: r, *Geum aleppicum* 3: r, *Lepidium apetalum* 2: r, *Mentha haplocalyx* 2: r, *Myosoton aquaticum* 4: +, *Persicaria mitis* 2: +, *Potentilla supina* 1: a, *Setaria viridis* 1: r, *Trifolium repens* 2: l, *Trigonotis peduncularis* 1: +;

E₀ – *Atrichum undulatum* 4: +, *Dicranodontium denudatum* 4: +, *Grimmia apocarpa* 4: +, *Hypnum pratense* 4: +.

Localities of relevés:

1-4: Hedju, lawn in the city, 4. 7. 1990, JK 281-284/90; **5-7:** Hedju, lawn in the city, 7. 7. 1990, JK 294, 292, 293/90.

Tab. 5. Pioneer plant communities at gravel and sand dune river alluvium.

Number of relevé	1	2	3	4	5	6	7	8	9
Relevé area (m ²)	30	30	30	30	90	30	16	60	30
Exposition	-	-	-	-	W	NE	NW	-	-
Slope (°)	0	0	0	0	3	15	20	0	0
Cover of shrub layer (%)	0	0	0	0	5	0	0	0	0
Cover of herb layer (%)	5	5	15	20	30	50	60	90	95
Cover of moos layer (%)	0	0	0	0	1	0	0	0	0
<hr/>									
E ₁									
<i>Artemisia capillaris</i>	.	r	l	a	a	.	.	.	.
<i>Carex pumila</i>	.	.	.	.	.	3	3	.	.
<i>Erigeron canadensis</i>	.	+	.	.	l	+	a	.	.
<i>Humulus japonica</i>	.	r	.	.	r	r	l	.	.
<i>Lepidium apetalum</i>	.	.	.	.	r	r	r	.	.
<i>Setaria viridis</i>	.	.	+	l	.	.	.	.	.
<i>Oenothera biennis</i>	.	.	+	+	.	.	.	.	.
<i>Lespedeza bicolor</i>	.	.	+	r	.	.	.	.	.
<i>Agrostis alba</i>	.	+	.	.	.	.	.	a	a
<i>Aster pinnatifidus</i>	.	.	.	.	+	.	.	l	+
<i>Calamagrostis epigeios</i>	.	.	.	.	.	.	.	a	a
<i>Artemisia japonica</i>	.	.	.	.	.	.	.	a	+
<i>Prunella asiatica</i>	.	.	.	.	.	.	.	l	+
<i>Viola verecunda</i>	.	.	.	.	.	.	.	+	+
<i>Viola mandshurica</i>	.	.	.	.	.	.	.	+	a
<i>Agrimonia pilosa</i>	.	.	.	.	.	.	.	r	l
<i>Erigeron annuus</i>	.	.	.	.	.	.	.	+	+
<i>Glycine soja</i>	.	.	.	.	.	.	.	+	+
<i>Amorpha fruticosa</i>	.	.	.	.	.	.	.	+	+
Common species:									
<i>Equisetum arvense</i>	+	.	.	r	+	a	l	+	l
<i>Lespedeza daurica</i>	.	.	a	a	+	.	r	+	+
<i>Cassia nomame</i>	.	.	+	+	l	.	.	+	l
<i>Rumex acetosella</i>	.	.	l	+	.	+	a	a	.
<i>Commelina communis</i>	.	.	+	l	.	+	a	.	+
<i>Agropyron *transiens</i>	.	.	+	+	.	.	+	l	a
<i>Trifolium repens</i>	.	.	.	.	.	+	+	+	a
<i>Phragmites japonica</i>	+	+	.	.	l	.	.	.	.
<i>Persicaria sieboldii</i>	r	r	.	.	.	.	.	.	+
<i>Persicaria lapathifolia</i>	.	+	.	.	r	r	.	.	.
<i>Kummerowia stipulacea</i>	.	.	+	l	.	.	.	.	a
<i>Zoysia japonica</i>	.	.	+	+	.	.	.	.	l
<i>Artemisia montana</i>	.	.	.	.	.	.	a	a	a
<i>Persicaria hydropiper</i>	+	+	.	.	.	.	.	.	.

<i>Cardamine flexuosa</i>	.	+	.	.	r	.	.	.	.
<i>Agropyron ciliare</i>	.	+	.	.	r	.	.	.	.
<i>Ambrosia artemisiifolia</i>	.	+	.	.	r	.	.	.	.
<i>Artemisia asiatica</i>	.	.	.	+	.	.	.	+	.
<i>Artemisia feddei</i>	.	.	.	+	.	.	.	l	.
<i>Plantago asiatica</i>	.	.	.	.	r	.	.	r	.
<i>Poa pratensis</i>	.	.	.	.	r	.	.	a	.
<i>Salix viminalis</i>	.	.	.	.	.	+	.	+	.
<i>Cerastium caespitosum</i>	.	.	.	.	.	.	+	.	+
<i>Bromus japonicus</i>	.	.	.	.	.	.	r	.	l

In one relevé:

E₂ – *Rhus javanica* 5: 1, *Salix* cf. *pierotii* 5: 1, *Securinega suffruticosa* 5: r, *Sorbaria sorbifolia* 5: 1, *Weigela praecox* 5: +;

E₁ – *Agastache rugosa* 5: r, *Achyranthes japonica* 8: +, *Aquilegia oxysepala* 5: r, *Artemisia rubripes* 5: a, *Barbarea orthoceras* 1: r, *Bidens frondosa* 2: +, *B. tripartita* 1: r, *Boehmeria spicata* 5: r, *Calystegia hederacea* 8: r, *Cardamine millsiana* 1: r, *Chelidonium majus* 5: +, *Chenopodium album* 6: r, *Chylocalyx senticosus* 7: 1, *Clematis serratifolia* 5: a, *Convolvulus chinensis* 6: +, *Corydalis pallida* 2: +, *Digitaria sanguinalis* 6: 1, *Duchesnea indica* 5: r, *Eragrostis multicaulis* 8: 1, *Glechoma hederacea* 8: +, *Impatiens balsamina* 1: r, *Lactuca raddeana* 5: +, *Lysimachia davurica* 8: +, *Lythrum anceps* 8: +, *Miscanthus sinensis* 8: +, *Myosoton aquaticum* 1: r, *Oenothera lamarckiana* 5: a, *Onoclea sensibilis* 8: 1, *Persicaria alata* 2: r, *P. thunbergii* 1: r, *P. vulgaris* 1: r, *Pinus densiflora* 3: r, *Potentilla chinensis* 4: r, *Pulsatilla koreana* 5: +, *Rorippa palustris* 2: +, *Rosa multiflora* 8: +, *Rubus crataegifolius* 5: r, *Sagina japonica* 2: r, *Sanguisorba officinalis* 9: +, *Securinega suffruticosa* 8: +, *Stachys japonica* 8: +, *Stellaria alsine* 9: +, *Taraxacum officinalis* agg. 8: r, *Thesium refractum* 5: r, *Torilis japonica* 9: +.

Localities of relevés:

1-2: Myohyang-san Mts, banks of the river Hyangsan-tschoon, 17. 6. 1990, JK 67, 70/90; **3-4, 6:** Kumgang-san Mts, sandy dunes near the village Samilpori on the banks of the river Namgang, 30. 6. 1990, JK 209, 210, 208/90; **5:** Myohyang-san Mts, banks of the river Hyangsan-tschoon, 19. 6. 1990, JK 78/90; **7-9:** Kumgang-san Mts, sandy dunes between the villages Samilpori and Onjongri, 30. 6. 1990, JK 213-215/90.

Tab. 6. Plant communities of shallow periodically flooded terrain depressions.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12
Relevé area (m ²)	16	20	30	10	30	20	16	25	30	30	15	30
Cover of herb layer (%)	40	40	50	80	80	85	50	50	70	90	80	35
E₁												
<i>Potamogeton vaseyi</i>	a	.	.	.	.	.	.	.	.	.	.	.
<i>Scirpus triqueter</i>	.	1	a	5	3	3	a	1	+	.	.	.
<i>Scirpus radicans</i>	.	.	.	.	.	.	.	3	.	.	.	.
<i>Scirpus yagara</i>	.	.	.	.	.	.	.	.	4	5	.	.
<i>Scirpus preslii</i>	.	.	.	.	.	.	.	.	.	1	3	1
Common species:												
<i>Persicaria thunbergii</i>	+	a	a	+	+	3	1	+	+	1	a	+
<i>Potamogeton distinctus</i>	a	a	1	1	r	.	.	.	.	+	+	+
<i>Aneilema japonica</i>	+	.	1	.	.	+	.	.	.	+	+	1
<i>Alisma canaliculatum</i>	.	.	+	.	r	r	.	.	.	.	+	r
<i>Alisma orientale</i>	1	.	a	.	.	r	.	.	.	.	.	3
<i>Lythrum anceps</i>	.	.	.	.	+	+	1	r	.	.	.	.
<i>Sium suave</i>	.	.	.	.	.	+	1	+	.	.	.	.
<i>Persicaria sieboldii</i>	.	.	.	.	.	+	+	+	.	.	.	.
<i>Agrostis alba</i>	.	.	.	.	.	.	+	.	.	a	1	.
<i>Stellaria alsine</i>	1	.	.	.	.	+	.	.	.	.	.	.
<i>Zizania latifolia</i>	.	a	.	.	.	.	.	.	+	.	.	.
<i>Typha angustata</i>	.	.	a	.	3	.	.	.	.	.	.	.
<i>Bidens cernua</i>	.	.	+	.	.	+	.	.	.	.	.	.
<i>Leersia oryzoides</i>	.	.	.	+	+	.	.	.	.	.	.	.
<i>Mentha haplocalyx</i>	.	.	.	.	+	.	.	.	.	.	.	r
<i>Lycopus maackianus</i>	.	.	.	.	r	+	.	.	.	.	.	.
<i>Bidens frondosa</i>	.	.	.	.	.	+	.	.	.	.	.	r
<i>Lysimachia davurica</i>	.	.	.	.	.	.	a	r	.	.	.	.
<i>Carex</i> sp.	.	.	.	.	.	.	1	a	.	.	.	.
<i>Phragmites communis</i>	.	.	.	.	.	.	r	1	.	.	.	.
<i>Eleocharis</i> sp.	.	.	.	.	.	.	.	.	.	r	3	.

In one relevé:

E₁: *Alopecurus amurens* 6: +, *Artemisia selengensis* 6: 1, *Bidens tripartita* 10: +, *Cassia nomame* 6: r, *Equisetum arvense* 6: +, *Juncus alatus* 6: 1, *J. decipiens* 6: 1, *Lemna paucicostata* 4: +, *Lobelia chinensis* 6: 1, *Oenanthe decumbens* 6: a, *Oxalis stricta* 6: 1, *Panicum bisulcatum* 6: +, *Phragmites japonica* 4: r, *Plantago asiatica* 6: +, *Prunella asiatica* 6: +, *Ranunculus chinensis* 6: +, *Rumex crispus* 7: +, *Salix gracilistyla* 1: +, *Scirpus tabernaemontani* 10: +, *Spirodela polyrhiza* 4: +, *Stachys japonica* 2: r, *Taraxacum officinalis* agg. 6: r, *Trifolium repens* 6: +, *Viola verecunda* 6: +.

Localities of relevés:

1-3, 6: Kumgang-san Mts, on the banks of the river Namgang near the village Samilpori, 30. 6. 1990, JK 206, 205, 204/90; **2, 4-5, 7-9:** Kumgang-san Mts, sandy dunes between the villages Samilpori and Onjongri, 30. 6. 1990, JK 221-223, 211-212, 224/90; **10-12:** Kumgang-san Mts, near the village Onjongri, right bank of the river Onjong-tschon, 1. 7. 1990, JK 235, 234, 232/90.