Plant communities dominated by *Salix gracilistyla* in Korean Peninsula and Japan

Ivan Jarolímek[1] & Jiří Kolbek[2]

[1]*Institute of Botany, Slovak Academy of Sciences, Dúbravská cesta 14, SK–84523 Bratislava, Slovakia; e-mail: ivan.jarolimek@savba.sk*

[2]*Institute of Botany, Academy of Sciences of the Czech Republic, CZ–25243 Průhonice, Czech Republic; e-mail: kolbek@ibot.cas.cz*

Abstract: Riverside vegetation dominated by *Salix gracilistyla* was analysed. In total, 77 phytocoenological relevés from Japan and both Korean Republics were compared. Based on 20 own relevés from Kumgang-san Mts (North Korea) a new association *Artemisio feddei-Salicetum gracilistylae* was described. It occupies alluvia of rivers and streams flooded for several times yearly. This species-rich community differs from the most similar, but species-poor association *Salicetum gracilistylae* Minamikawa 1963, described from Japan and known also from South Korea by numerous differential taxa.

Key words: North-East Asia, riverside vegetation, *Salicion gracilistylae*, vegetation classification

Introduction

In North Korea, phytocoenological research of vegetation was performed in the years 1986 to 1990. Along with forests, pioneer vegetation in the rock fissures and synanthropic communities (Neuhäusl & Neuhäuslová, 1994; Kolbek & Sádlo, 1996; Kolbek et al., 1997, 2003; Sádlo & Kolbek, 1997; Kolbek et al., 1998; Kolbek et al. 2003) also riverside communities were studied. Their floristic composition and ecology were investigated mainly along the Namgong river and its tributary Onjong river in the Kumgang-san Mts. Small partially developed stands occurred in the Myohyang-san Mts and Sujang-san Mts. Fully developed stands with *Salix gracilistyla* were found in the Kumgang-san Mts. In the Sujang-san Mts the transition vegetation between the grass association *Phragmitetum japonicae* and open shrubs dominated by *Salix gracilistyla* was found. In the Myohyang-san Mts the species *Salix gracilistyla* is very rare, distributed near the streams and local rivers. Plant communities dominated by *Salix gracilistyla* were also studied in Japan (Minamikawa, 1963; Miyawaki, 1981–1988) and South Korea (Song & Song, 1996; Song, 2001).

All communities dominated by *Salix gracilistyla* occupy similar habitats: the banks of rivers and streams in colline and montane belts. They are frequently influenced by floods mainly in spring and summer monsoon time. In the upper stream of the Namgong river in the Kumgang-san Mts the bed of mountain river is steep, narrow and covered by large blocks of boulders, almost without vegetation. Only small stands of *Phragmites japonica* belonging to species-poor bank vegetation overgrow it. Stream falls down toward the east foothills of mountains and it flows across about ten kilometres wide lowland to the East (Japanese) Sea near the Samilpo Lake.

On the riversides of the Namgong river and its isles several communities were found:

1. Community with *Phragmites japonica* in the middle of the stream, on the large stone or gross gravel alluviums.
2. Community dominated by *Salix gracilistyla* in low stream on sandy boulder, gravely sandy or sandy alluviums.
3. Grasslands dominating by the species *Scirpus triqueter* and *S. preslii* were also found on the contiguous terraces in shallow depressions with standing water. In North Korea these communities looking like moist or wet meadows occur rarely.

Comparison of floristic composition of available phytocoenological data on *Salix gracilistyla* communities and their classification was the aim of this work.

Material and methods

Riverside vegetation was analysed and synthesised using Braun-Blanquet approach (Braun-Blanquet, 1964). In the year 1990 twenty relevés of *Salix gracilistyla* stands were obtained mainly along the Namgong river in the Kumgang-san Mts. With regard to the line character of

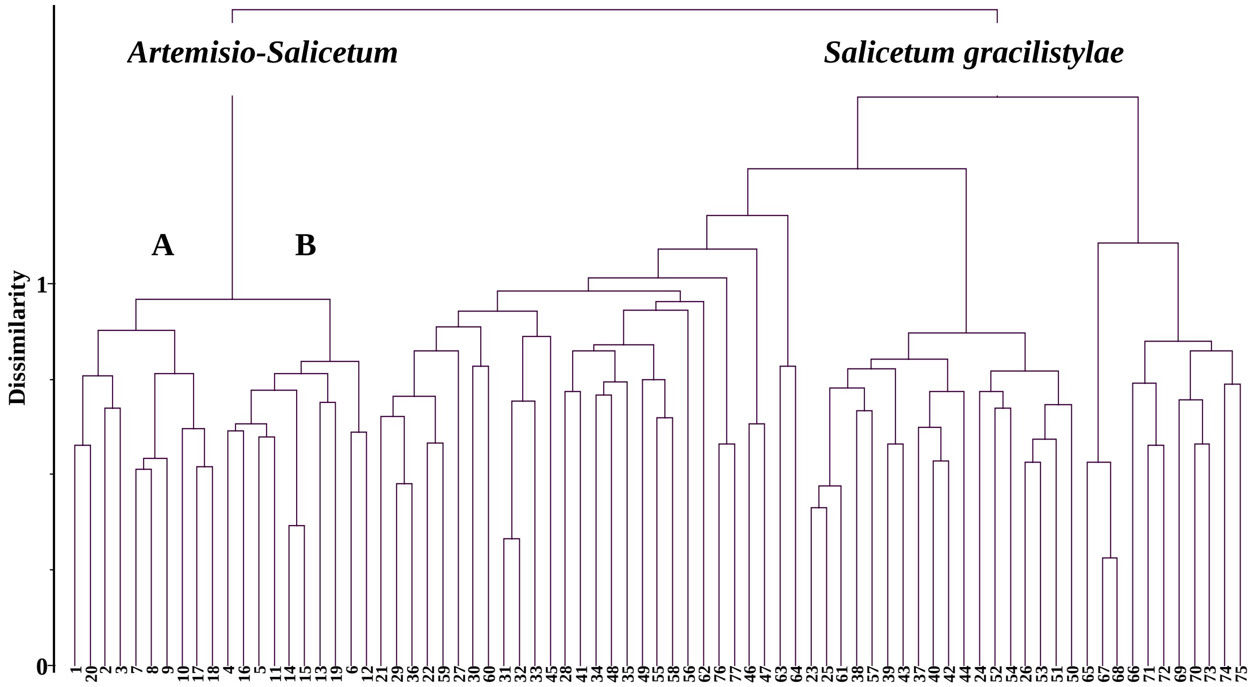

Fig. 1. Numerical classification of 77 phytocoenological relevés from Japan, North and South Korea. A = *Artemisio-Salicetum spodiopogonetosum sibiricae*; B = *Artemisio-Salicetum artemisietosum capillaris.*

stands the sampling plots were narrow rectangles. The quantity of mud, sand, gravel and stones were registered in every relevé. We investigated relationships between granularity of sediments and floristic composition of vegetation. In the stands mosses and lichens were not found. For numerical analysis and comparison of this vegetation, 55 relevés, 2 constancy columns from Japan (MIYAWAKI, 1982–1988) and 2 relevés from South Korea (SONG & SONG, 1996; SONG, 2001) were used.

Before numerical classification the values of abundance and dominance were transformed to the nines degree ordinal scale (MAAREL, 1979). Cluster analysis was performed using program HIERCLUS from SYN-TAX 2000 package (PODANI, 2001). β-flexible clustering method ($\beta = -0.25$) and RUŽIČKA's coefficient was used. Following yielded dendrogram (Fig. 1) the phytocoenological table was arranged. The names of plants follow RI & HWANG (1984) except of *Solidago gigantea* Aiton (not given in the List of North Korean species names).

Results

Artemisio feddei-Salicetum gracilistylae ass. nova hoc loco
Nomenclatural type: Tab. 1, rel. 20
Diagnostic taxa: *Salix gracilistyla* (dom.), *Agropyron tsukushiense*, *Artemisia asiatica*, *A. capillaris*, *A. feddei*, *Commelina communis*
Low shrub willows determine the physiognomy and vertical structure of the community. The shrub *Salix gracilistyla* usually prevails (Fig. 2); *S. gilgiana* and *S. koriyanagi* are regularly present, and in some places also *S. rorida* and *S. siuzevii* occur. Slightly gapped stands with total cover 80–98% are mostly 90–160 cm in height. Beside the above-mentioned willows, herbs and graminoids, such as *Phragmites japonica*, *Phalaris arundinacea*, *Artemisia asiatica*, *A. capillaris*, *A. feddei*, and *Agropyron tsukushiense* var. *transiens* often participate in the upper, denser layer from 60 to 160 cm. The ground layer up to 60 cm consists mainly of the therophytes such as *Bidens frondosa*, *Cassia nomame*, *Commelina communis*, *Equisetum arvense*, *Persicaria sieboldii* and *P. thunbergii* (see Tab. 1). In both layers the herb liana *Humulus japonica* occurs. The community is medium rich in species (18.2 species per relevé, min. 10, max. 27). Floristic composition of the community depends on habitat conditions and is very changeable. The species of similar grow strategy growing in Central Europe, such as *Humulus lupulus*, and other geographical vicariants of the various genera as *Artemisia, Salix*, etc., together with identical species *Phalaris arundinacea, Equisetum arvense, Bidens frondosa, Salix purpurea, Phragmites communis,* characterise similar communities in the alluviums of Northeast Asia, too.

Diversity of species composition in the association *Artemisio-Salicetum* is also very high. In our 20 relevés from Kumgang-san Mts 88 species of vascular plants were found. However, the number of species with high constancy in this group is very low. In the phytocoenological table (Tab. 1) only 8 taxa belong to V and IV constancy class. However, 65 species belong to the first class. This fact generally corresponds with dynamic suc-

Fig. 2. The *Salix gracilistyla* stands on sand river bank of the Namgong River (Kumgang-san Mts, North Korea). Photo by J. Kolbek.

Fig. 3. Riverside vegetation along the Namgong River (Kumgang-san Mts, North Korea). Photo by J. Kolbek.

cession of riverside communities. The reason could dwell in disturbance of the community repeated yearly for several times.

The community usually colonizes the first riverside zone close to the river water level or gravely sandy alluvium river terraces 0.5 to 1.5 m above the summer water level (Fig. 3). It also occurs on river islets. The community prefers more fine sediments in the lower stream of the river. Primitive soils are mostly sandy, gravely sandy, in the middle of the stream with higher share of boulders of different size. In the middle of the stream the community dominated by the species *Phragmites japonica* alters the association *Artemisio-Salicetum gracilistylae*. The habitats are yearly flooded probably for several times by torrential water and the stands of the community are repeatedly damaged or destroyed. These floods influence high variability in species composition, especially in the herb layer. Beside the irregular disturbance of habitats the role of nutrient deposition from the surrounding (forest) communities is important. Torrential water moves mainly the fine sediments. The stands are alternately silted up with sediments or on the contrary their substratum is washed out. The dominant species *Salix gracilistyla* is well adapted to both situations. On buried limbs or to ground set limbs the roots grow quickly. They pene-

Table 1. The association *Artemisio feddei-Salicetum gracilistylae* in Kumgang-san Mts (North Korea).

Syntaxa/constancy	A	CA%	B	CB%	CA+B%
Number of relevés	2 111		1 11111 1		
	1023789078		4651453962		
Number of species	2221111111		2112112121		
	5011403622		1995987967		
Artemisio-Salicetum					
Salix gracilistyla	5554555545	100	445555334a	100	100
Artemisia asiatica	+1+1+.111+	90	a+1++++a++	100	95
Artemisia feddei	b+1b..11..	60	11+111a1b.	90	75
Commelina communis	+.+1+++.11	80	111+...1++	70	75
Agropyron tsukushiense	+++...++.+	60	+++++++.+.	80	70
Artemisio-Salicetum spodiopogonetosum sibiricae					
Persicaria thunbergii	...b+r+r.+	60	..a+....1.	30	45
Spodiopogon sibiricus	+1...11+..	50	........++	20	35
Orthodon punctatum	....+r++..	40	....	0	20
Stephanandra incisa	r1+.......	30	....	0	15
Viola verecunda	+.++......	30	......+...	10	20
Viola yezoensis	..++....r.	30	....	0	15
Artemisio-Salicetum artemisietosum capillaris					
Cassia nomame	r...mr....	30	++++++++++	100	65
Rumex acetosella	+......+..	20	a++++.++.+	80	50
Artemisia capillaris	..+.....r.	20	111+111.+.	80	50
Equisetum arvense	....1...1.	20	.+++++.++1	80	50
Oenothera lamarckiana	1.........	10	.r.rr+...+	50	30
Agrostis stolonifera	....	0	....+++.+.	40	20
Salix rorida	....	0	+b....+...	30	15
Juncus decipiens	....	0	..+...++..	30	15
Trifolium repens	....	0	...++..+..	30	15
Aster pinnatifidus	....	0	...r..++..	30	15
Erigeron annuus	....	0	....1+1...	30	15
Salix siuzevii	....	0	......1.33	30	15
Other taxa					
Phragmites japonica	11a1+11.++	90	1..11+..++	60	75
Salix gilgiana	....11.+11	50	a.1.1a33+a	80	65
Salix koriyanagi	.......1b1	30	1a.+11...1	60	45
Poa pratensis	+.+....+++	50	.....+.++.	30	40
Humulus japonica	...1+.+...	30	++++...1..	50	40
Persicaria sieboldii	....+r+...	30	..++..r1+.	50	40
Bidens frondosa	....+r.+..	30	...++.m.++	50	40
Phalaris arundinacea	..+....+..	20	.1..+.+++.	50	35
Stachys japonica	+r........	20	...+..+.rr	40	30
Lysimachia davurica	+++.......	30	......r.+.	20	25
Calamagrostis sp.	..+....++.	30	...1..+...	20	25
Rosa multiflora	11........	20	.r.+......	20	20
Lespedeza bicolor	r.r.......	20	.....++...	20	20
Cuscuta japonica	..+....1.1	30	.....+....	10	20
Cosmos bipinnata	......r...	10	.r+...r...	30	20
Arthraxon hispidus	+...+.....	20	..+.......	10	15
Cerastium sp.	+........+	20	...r......	10	15
Artemisia japonica	.......+..	10	+.....1...	20	15
Rubus parvifolius	a1........	20	....	0	10
Robinia pseudo-acacia	+1........	20	....	0	10
Vicia unijuga	++........	20	....	0	10
Celastrus orbiculatus	+.+.......	20	....	0	10
Oenothera biennis	.1........	10	.......+..	10	10
Agrimonia pilosa	.r........	10	r.........	10	10
Chylocalyx senticosus	..r.......	10	r.........	10	10
Bidens maximowicziana	...1......	10	..+.......	10	10
Chylocalyx perfoliatus	...+......	10	.+........	10	10
Bidens tripartita	........+.	10	.......+..	10	10
Glycine soja	....	0	r.......+.	20	10
Erigeron canadensis	....	0	.+.+......	20	10
Lepidium apetalum	....	0	.r...r....	20	10
Calystegia japonica	....	0	..+......+	20	10
Populus nigra	....	0	...+.....r	20	10
Lespedeza sp.	....	0	....++....	20	10
Carex pumila	....	0	........++	20	10

trate relatively deep into the soil – in the washed bank we found roots 1.5 m below the soil surface.

Within the association two subassociations were distinguished:

1. *Artemisio feddei-Salicetum gracilistylae spodiopogonetosum sibiricae* subass. nova hoc loco (nomenclatural type: identical with the association name)

Differential species: *Orthodon punctatum*, *Persicaria thunbergii*, *Spodiopogon sibiricus*, *Stephanandra incisa*, *Viola verecunda*, *V. yezoensis*

The subassociation occurs in studied area prevailingly in higher flow part of the river at habitats with higher share of gravel and granite boulders.

2. *Artemisio feddei-Salicetum gracilistylae artemisietosum capillaris* subass. nova hoc loco (nomenclatural type: Tab. 1, rel. 16)

Differential species: *Agrostis stolonifera*, *Artemisia capillaris*, *Aster pinnatifidus*, *Cassia nomame*, *Equisetum arvense*, *Erigeron annuus*, *Juncus decipiens*, *Oenothera lamarckiana*, *Rumex acetosella*, *Salix rorida*, *S. siuzevii*, *Trifolium repens*

In North Korea, the subassociation prefers middle or low flow parts of the river with sandy or silt sediments.

Discussion

Classification

The association *Artemisio feddei-Salicetum gracilistylae* belongs to the alliance *Salicion gracilistylae* Ohba 1973, order *Alno-Salicetalia serissaefoliae* Ohba 1973, and class *Salicetea sachalinensis* Ohba 1973. The alliance *Salicion gracilistylae* is characterised as colline and (sub-)montane alluvial willow communities occurring in Japan and Korea (Kolbek et al., 2003). The other associations of the alliance *Salicion gracilistylae*, such as *Coriaio-Elaeagnetum umbellatae* Okuda 1978 and *Salicetum gracilistylae* Minamikawa 1963 have not been found in the northern part of the Korean Peninsula.

A typical feature of the alliance *Salicion gracilistylae* is the high number of accessory species consequent to strong seasonal dynamics of its habitats. Floods influence the changes in sedimentation and erosion of soil and bring many diaspores of various species from higher situated riverine communities.

The more floristic similar association *Salicetum gracilistylae* is known especially from different regions of Japan. At present, the general synthesis of communities dominated by *Salix gracilistyla* for the whole area of Northeast Asia is not provided. Only relevés from Japan, partially from southern part and just from northern Korean Peninsula are available. The occurrence of these communities can be expected on whole area of natural distribution of the dominant species of shrub layer – *Salix gracilistyla*, e.g. in Russian Far East and in the neighbouring area of China (Voroshilov, 1966, 1972; Czerepanov, 1981; Anonymous, 1982; Charkevicz, 1995). In the European part of the Russia the species is not occurred (Stankov & Taliev, 1949). In Far East, in Japan, the *Salicetum gracilistylae* is mentioned from the islands Honshu (Minamikawa, 1963), Shikoku (Miyawaki 1982: p. 132, 11 rels), Chugoku (Miyawaki 1983: p. 133, 14 rels), Kinki (Miyawaki 1984: tab. 24, 7 rels), Chubu (Miyawaki 1985: tab. 26, 12 rels), Kanto (Miyawaki 1986: tab. 18, 4 rels), Tohoku (Miyawaki 1987: tab. 32, 7 rels) and Hokkaido (Miyawaki 1988: tab. 21, 2 rels). In the Yakushima Island only communities of the second order (*Sedo-Salicetalia subfragilis* Ohba 1978) of the class were found on the bank of a stream (Miyawaki, 1981). The species *Salix gracilistyla* grows also in the *Aster ageratoides* var. *angustifolius-Arundinella hirta* community (Miyawaki 1981: tab. 44) with a lower abundance (+ – 2).

Closely related association *Salicetum gracilistylae* was described by Minamikawa (1963) from the riverside of the Yahagi river (Middle Honshu, Japan). Description of this association is based on constancy table with 7 species. Among them only the species *Salix gracilistyla* attains constancy class V and two species (*Salix gilgiana* and *Persicaria sieboldii*) occur also in the similar stands in the North Korea. Following this description Miyawaki (l. c.) ordered stands dominated by *Salix gracilistyla* from Japan into the association *Salicetum gracilistylae* and documented it by 55 phytocoenological relevés from 7 Japan islands, but curiously not from the island Honshu.

From South Korea Song & Song (1996) brought two relevés of the association with the name *Salicetum gracilistylae* from the Nak-Dong river catchment area, commonly with the new described association *Salicetum graciliglandis*. The same two phytocoenological relevés of *Salicetum gracilistylae* were published later by Song (2001). Three relevés of the association *Salicetum graciliglandis* are differentiated from *Salicetum gracilistylae* mainly by the alternation of dominant *Salix* species in the shrub layer only. The floristic composition of both units from this territory is very species-

←

Species in one relevé:
Actinidia kolomicta +(20), *Albizzia julibrissin* r(20), *Alisma orientale* r(6), *Arenaria serpyllifolia* r(20), *Artemisia annua* +(19), *A. montana* +(20), *Bidens bipinnata* +(7), *Cerastium caespitosum* +(4), *Chelidonium majus* r(2), *Diarrhena japonica* +(20), *Digitaria* sp. +(9), *Fraxinus rhynchophylla* r(1), *Imperata cylindrica* +(6), *Juglans mandshurica* r(4), *Lactuca bungeana* r(2), *Lespedeza cuneifolia* +(13), *Lycopus* sp. +(11), *Lysimachia clethroides* +(1), *Melandrium firmum* r(4), *Mentha arvensis* r(5), *Myosoton aquaticum* +(4), *Persicaria hydropiper* +(18), *Plantago asiatica* +(13), *Salix caprea* +(14), *S. matsudana* 1(19), *Solidago gigantea* 1(6), *Staphylea bumalda* r(2), *Trifolium pratense* r(6), *Viola patrini* +(13).

poor and partially similar. Comparison of either two or three relevés is not adequate for sufficient distinguishing of these communities.

Comparison of 20 phytocoenological relevés from North Korea and 57 published relevés from Japan and South Korea shows low similarity of both data sets (Fig. 1). All 20 relevés of *Artemisio-Salicetum* collected in North Korea are concentrated in the groups A and B of the dendrogram. The difference between *Artemisio-Salicetum* and *Salicetum gracilistylae* is clearly evident. Heterogeneity of the published relevés of the *Salicetum gracilistylae* is so high, that rational classification of this unit needs more phytocoenological data from larger area.

Phytocoenological relevés from the North Korea differ from the *Salicetum gracilistylae* by higher number of species, which is twice as high as in Japan and South Korean relevés, and by high constancy of species *Artemisia asiatica*, *A. feddei*, *A. capillaris*, *Agropyron tsukushiense*, *Cassia nomame* and *Salix gilgiana*. All these species reach frequency higher than 50%. The communities from Japan and South Korea are extremely heterogeneous. Evaluation of the Japanese material is complicated by its dividing into 8 subassociations by MIYAWAKI (l. c.). Moreover, some of them were described on the basis of one relevé only. Among the species with higher constancy only the species *Salix gracilistyla*, *Phragmites japonica*, *Persicaria thunbergii*, and *Equisetum arvense* are common for both associations. They differ from the North Korean community by the presence of the species *Artemisia princeps* (49%), and several species with constancy lower than 30%, such as *Miscanthus sinensis*, *Salix sachalinensis*, *S. integra*, and *Cryptotaenia japonica*. Floristic differentiation between the communities in Japan and North Korea resulted in description of the new association, *Artemisio feddei-Salicetum gracilistylae*, in this paper.

Development and succession

The association *Artemisio-Salicetum gracilistylae* is an example of alluvial shrub community influenced by repeated disturbances during its development. It forms a blocked succession stage typical for riverside alluvial communities. Regression development to the earlier stage after floods is a repeating process continuing in this community in natural country for a long period.

On the streams and rivers with boulder banks we observed following topographic relations:

1. boulder bank without vegetation in the upper stream,

2. initial vegetation with *Phragmites japonica* on (sandy)-boulder substratum,

Kumgang-san, alluvium of the Onjong river, near the village Onjongri, 27. 6. 1990, J. KOLBEK, –, 0°, 3 × 10 m, E_1 = 60%

E_1 (herb layer): *Phragmites japonica* 3, *Salix gracilistyla* 3, *Artemisia asiatica* 1, *Rosa multiflora* 1, *Artemisia feddei* +, *Viola verecunda* +, *Agrimonia pilosa* r, *Commelina communis* r, *Diarrhena japonica* r, *Lactuca bungeana* r, *Lespedeza daurica* r, *Plantago asiatica* r, *Viola mandshurica* r.

3. closed stands with *Phragmites japonica* (*Phragmitetum japonicae* MINAMIKAWA 1963) on sandy-boulder substratum,

Kumgang-san, the left bank tributary of the Onjong river, ca 2 km W of the village Onjongri, 1. 7. 1990, J. KOLBEK, –, 0°, 2 × 10 m, E_1 = 85%,

E_1 (herb layer): *Phragmites japonica* 5, *Achyranthes japonica* 2, *Artemisia japonica* 2, *Salix gracilistyla* 1, *Viola verecunda* 1, *Arthraxon hispidus* +, *Stephanandra incisa* +, *Aster scaber* r, *Pinus densiflora* r, *Plantago asiatica* r.

4. transition vegetation between *Phragmitetum japonicae* and open shrubs dominated by *Salix gracilistyla* in the middle stream on sandy-boulder substratum; this stage is documented by following phytocoenological relevé:

Sujang-san, fringe stands along the boulder riversides of the mountain stream, 6. 7. 1990, J. KOLBEK, –, 0°, 20 m^2, E_1 = 85%

E_1 (herb layer): *Phragmites japonica* 3, *Securinega suffruticosa* 3, *Boehmeria spicata* 2, *Salix gracilistyla* 2, *Stephanandra incisa* 2, *Chrysanthemum indicum* 1, *Rhododendron mucronulatum* 1, *Rhus chinensis* 1, *Rubus crataegifolius* 1, *Acer pseudosieboldianum* +, *Aralia controversa* +, *Aster pallasianum* +, *Benzoin obtusilobum* +, *Fagara schinifolia* +, *Indigofera kirilowii* +, *Lespedeza bicolor* +, *Viola collina* +, *V. verecunda* +, *Weigela florida* +, *Acer mono* r.

5. juvenile species-poor to species-rich stage of the association *Artemisio-Salicetum gracilistylae* on sandy-boulder substratum with low cover of shrub layer,

Kumgang-san, dry, stony alluvium of the Onjong river, 27. 6. 1990, J. KOLBEK, –, 0°, 20 × 5 m, E_2 = 45%, E_1 = 50%

E_2 (shrub layer): *Robinia pseudo-acacia* 2, *Rosa multiflora* 2, *Salix gracilistyla* 2, *Spiraea japonica* 2, *Stephanandra incisa* 2, *Pinus densiflora* 1, *Weigela florida* 1, *Callicarpa japonica* +, *Fraxinus rhynchophylla* +, *Lespedeza bicolor* +, *Palura paniculata* +, *Quercus mongolica* +, *Styrax obassia* +, *Vitis amurensis* +, *Acer pseudosieboldianum* r, *Clematis tubulosa* r, *Kalopanax pictus* r, *Lespedeza maximowiczii* r, *Staphylea bumalda* r, *Syringa venosa* r, *Tilia* sp. r,

E_1 (herb layer): *Spodiopogon sibiricus* 3, *Phragmites japonica* 2, *Carex lanceolata* 1, *Agropyron tsukushiense* var. *transiens* +, *Artemisia feddei* +, *Galium verum* +, *Isodon excelsus* +, *Lysimachia vulgaris* var. *davurica* +, *Patrinia scabiosaefolia* +, *Artemisia asiatica* r, *A. capillaris* r, *Chylocalyx senticosus* r, *Commelina communis* r, *Diarrhena japonica* r, *Dioscorea* sp. r, *Lepidium apetalum* r, *Oenothera biennis* r.

6. species medium-rich stage with high cover of shrub layer on sandy-gravel or muddy-sandy substratum with sparse boulders in the low part of the river (Tab. 1). The following succession of this stage

CMYK

to the more closed forest alluvial communities is blocked.

Distribution

Contemporary insufficient of the phytocoenological data restricts the validity of a synthesis of the communities with *Salix gracilistyla* in Northeast Asia. These communities are relatively well known in Japan. The total number of relevés from Northeast Asia is very low and a representative comparison is limited by unequal size of data sets from the individual areas. However, the distribution of these communities is insufficiently known: we visited several other mountain regions in North Korea (e.g. Changbai-san, Chonma-san, Ljongak-san, Myohyang-san, Sujang-san, Taesong-san), and we found the fully developed stands of the association *Artemisio-Salicetum gracilistylae* only in Kumgang-san Mts. We expect the occurrence of this community also in other parts of the Korean Peninsula.

Acknowledgements

The paper was supported by the project of Grant Agency of the Czech Republic No. 206/05/0119 “Plant communities of the Korean Peninsula: the first vegetation synthesis of less known area”. For kindly sending the reprint of original diagnosis of the association *Salicetum gracilistylae* the authors thank professors J. S. SONG and M. MINAMIKAWA. The authors thank also Dr. Z. NEUHÄUSLOVÁ for kindly providing the literature, Dr. J. SÁDLO for his help in the field, and the colleagues from the Institute of Botany of D. P. R. K., Pyongyang, for scientific cooperation.

References

ANONYMOUS, 1982. Iconographia Cormophytorum Sinicorum, Suppl. I. Being.

BRAUN-BLANQUET, J. 1964. Pflanzensoziologie. Grundzüge der Vegetationskunde. 3rd ed. Springer Verlag, Vienna, New York.

CHARKEVICZ, S.S. 1995. Plantae vasculares orientalis extremi Sovietici. Tom 7. Nauka, Saint Petersburg. (in Russian)

CZEREPANOV, S.K. 1981. Sosudistyje rastenia SSSR. (Vascular plants of the Soviet Union.) Nauka, Leningrad. (in Russian)

KOLBEK, J. 1995. Notes on epiphytic communities in forests of North Korea. Preslia **67:** 41–45.

KOLBEK, J., JAROLÍMEK, I. & VALACHOVIČ, M. 1997. Plant communities of rock habitats in North Korea: 1. Communities of semi-dry rocks. Biologia, Bratislava, **52:** 503–522.

KOLBEK, J., JAROLÍMEK, I. & VALACHOVIČ, M. 2003. Forest vegetation of the northern Korean Peninsula, pp. 263–361. In: KOLBEK, J., ŠRŮTEK, M. & BOX, E. O. (eds), Forest vegetation of Northeast Asia. Geobotany 28, Kluwer Academic Publishers, Dordrecht, Boston, London.

KOLBEK, J. & SÁDLO, J. 1996. Some short-lived ruderal plant communities of non-trampled habitats in North Korea. Folia Geobot. Phytotax. **31:** 207–217.

KOLBEK, J. VALACHOVIČ, M., ERMAKOV, N. & NEUHÄUSLOVÁ, Z. 2003: Comparison of forest syntaxa and types in Northeast Asia, pp. 409–423. In: KOLBEK, J., ŠRŮTEK, M. & BOX, E. O. (eds), Forest vegetation of Northeast Asia. Geobotany 28, Kluwer Academic Publishers, Dordrecht, Boston, London.

KOLBEK, J., VALACHOVIČ, M. & JAROLÍMEK, I. 1998. Plant communities of rock habitats in North Korea: 2. Communities of moist rocks. Biologia, Bratislava, **53:** 37–51.

MAAREL, E. VAN DER, 1979. Transformation of cover abundance values in phytosociology and its effects on community similarity. Vegetatio **39:** 97–114.

MINAMIKAWA, M. 1963. Phytosociological studies of the plant communities on the river-bach of the river Yahagi and its tributaries. In: HIRO, M. (ed.) Nature in Yahagi river, College of Nagoya Women’s University, Nagoya, 287 pp.

MIYAWAKI, A. (ed.) 1981. Vegetation of Japan. Vol. 2. Kyushu. Shibundo, Tokyo. 486 pp.

MIYAWAKI, A. (ed.) 1982. Vegetation of Japan. Vol. 3. Shikoku. Shibundo, Tokyo. 542 pp.

MIYAWAKI, A. (ed.) 1983. Vegetation of Japan. Vol. 4. Chugoku. Shibundo, Tokyo. 542 pp.

MIYAWAKI, A. (ed.) 1984. Vegetation of Japan. Vol. 5. Kinki. Shibundo, Tokyo. 598 pp.

MIYAWAKI, A. (ed.) 1985. Vegetation of Japan. Vol. 6. Chubu. Shibundo, Tokyo. 606 pp.

MIYAWAKI, A. (ed.) 1986. Vegetation of Japan. Vol. 7. Kanto. Shibundo, Tokyo. 644 pp.

MIYAWAKI, A. (ed.) 1987. Vegetation of Japan. Vol. 8. Tohoku. Shibundo, Tokyo. 608 pp.

MIYAWAKI, A. (ed.) 1988. Vegetation of Japan. Vol. 9. Hokkaido. Shibundo, Tokyo. 563 pp.

NEUHÄUSL, R. & NEUHÄUSLOVÁ, Z. 1994. Vegetation belts and community patterns in Central Korean mountain ranges. Phytocoenologia **24:** 155–165.

PODANI, J. 2001. SYN-TAX 2000. Computer program for data analysis in ecology and systematics for Windows 95, 98 & NT. User’s manual. Scientia Publ., Budapest, 53 pp.

RI, J.D. & HWANG, H.D. 1984. List of plant names. Scientific encyclopaedia Publ. Pyongyang. 544 pp. (in Korean)

SÁDLO, J. & KOLBEK, J. 1997. The terrestrial ruderal and segetal vegetation of North Korea. Folia Geobot. Phytotax. **32:** 25–40.

SONG, J.S. 2001. A phytosociological study of the shrubby and herbaceous vegetation of the riverside in the upper stream of Nak-dong river, Korea. Korean J. Env. Ecol. **15:** 104–117. (in Korean)

SONG, J.S. & SONG, D.S. 1996: A phytocoenological study on the riverside vegetation around Hanchon, upper stream of Nak-tong River. Korean J. Ecol. **19:** 431–451. (in Korean)

STANKOV, S.S. & TALIEV, V.I. 1949. Opredelitel vyssich rastenij evropejskoj casti SSSR. (Determination key of vascular plants of the European part of the Soviet Union.) Sovetskaja Nauka, Moskva. (in Russian)

VOROSHILOV, V.N. 1966. Flora Sovetskogo Dalnego Vostoka. (Flora of the Soviet Far East.) Nauka, Moskva. (in Russian)

VOROSHILOV, V.N. 1982. Opredelitel rastenij Sovetskogo Dalnego Vostoka. (Determination key of plants of the Soviet Far East.) Nauka, Moskva. (in Russian)

Received Oct. 15, 2005
Accepted Nov. 10, 2005

Location of relevés

Relevés 1–19 were obtained in riversides of Namgong River flowing from Kumgang-san Mts to Samilpo Lake and to Pacific Ocean on June 27 to July 1, 1990. Authors of relevés: I. JAROLÍMEK (1–19), J. KOLBEK (20). Description of locality is followed by data on exposition, slope, relevé area, cover of herb layer, and height of stand.

Abbreviations: R = right bank, and L = left bank of the river.

1. Foothill of the mountain, R, 1.6 m above the water level, sandy substratum with big boulders; NNW, 10°, 3 ×10 m, 90%, 70–100 cm.
2. R, bottom of the oxbow, in time of relevé sampling without water, 30–50 cm above the water level, sandy-boulder substratum; SSE, 5°, 4 × 8 m, 85%, 70–110 cm.
3. R, high share of fine-grained silt particles among boulders, –, 0°, 5 × 6 m, 90%, 60–120 cm.
4. L, partially bared sandy-boulder bottom, –, 0°, 3 × 15 m, 90%, 70–100 cm.
5. L, sandy bottom with sparse boulders, –, 0°, 3 × 10 m, 95%, 90–120(200) cm.
6. L, muddy-sandy substratum with sparse boulders, –, 0°, 4 × 10 m, 98%, 90–150 cm.
7. Islet in the river, sandy-gravel substratum without boulder, –, 0°, 4 × 10 m, 80%, 80–130 cm.
8. L, sand, –, 0°, 4 × 8 m, 80%, 50–120 cm.
9. Islet in the river, sand, –, 0°, 2.5 × 15 m, 95%, 100 cm.
10. Islet in the river, sand, –, 0°, 4 × 10 m, 90%, 100 cm.
11. L, sand, –, 0°, 3 × 15 m, 95%, 70–120 cm.
12. L, sand, –, 0°, 3 × 15 m, 90%, 100 cm.
13. L, muddy-sandy bank, –, 0°, 4 × 8 m, 85%, 90 cm.
14. Islet in the river, near Samilpo Lake, sand, –, 0°, 4 × 8 m, 95%, 80 cm.
15. Islet in the river, near Samilpo Lake, sand, –, 0°, 5 × 6 m, 90%, 60–90 cm.
16. L, sand, –, 0°, 3 × 10 m, 90%, 70–140 cm.
17. R, sandy-gravel substratum, –, 0°, 5 × 6 m, 90%, 70–120 cm.
18. Islet in the river near R, sand, –, 0°, 3 × 10 m, 90%, 80–110 cm.
19. R, sand, –, 0°, 5 × 8 m, 90%, 90–160 cm.
20. Kumgang-san Mts, Onjong River (tributary of Namgong River), near the village Onjongri, R, dry stony alluvium, –, 0°, 5 × 8 m, 95%, 140 cm.