FINAL REPORT
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WG VI: Landscape analysis

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Content:	**Plant - water interplay in urban river valley – identification of hot-spots for river rehabilitation** 1. Summary 2. Aims 3. Study area, material and methods 4. Results 5. Conclusions 6. Next steps 7. Summary

1. Summary

WG 6. Plant community distribution – development of phytosociological maps of the river valley for estimation of biodiversity and optimalization of water retentiveness in the landscape

In 2007, the aim of the *WG 6* research was to define a current status of the Sokolowka River and its valley with a special focus on a river-valley connectedness and identification of hot spots for rehabilitation activities. In order to achieve this aim, a system of ground water monitoring has been set up (six transects of piezometers in representative sections of the valley) and the first phase of plant cover valuation has been completed. The results indicated areas of water stress in the valley and its proximity (groundwater level in summer months 2,5m and below) that require special attention whileplanning a re-meandering of the river and establishing green areas there. There were also sections of high connectedness, supporting development of vegetation characteristic for river valleys e.g. riverside ash-alder forest *Fraxino-Alnetum*. They were characterized with groundwater level oscillating between 0,5-1m and influence on water chemistry e.g. about 70% reduction of NO_3 within 15m range from the river. Such areas could be recommended as i) buffering zones supporting self-purification of ground and surface waters, ii) areas enhancing water retentiveness, iii) cores of future greens and iv) shelters of urban biodiversity.
To test the efficiency of the present land-water ecotones as buffering zones, the chemistry of ground and surface water has been studied and compared, and biomass was estimated for each plant community along transects. The 2008 research has been scoped on defining the ability of different vegetation types to accumulate P, N and heavy metals, considering the contribution of different species and seasonal biomass production, and their role in water circulation.
In order to assess the role of vegetation in improving landscape esthetics, enhancing biodiversity, and supporting spatial planning, the advanced phytosociological studies have been initiated thatare also expected to contribute to defining gradients of naturalness (therefore to the planning of necessary engineering and ecohydrological solutions). Furthermore, they serve as an a means of identification of the best plant indicators of soil properties – with respect to moisture, fertility and anthropogenic stress, which will facilitate the process of up-scaling the environmental assessment to the whole catchment.

2. Aims

The aims of the project include:
- defining the river – valley connectedness through vegetation analysis (species composition and biomass distribution),
- observation of ground water dynamics (in comparison to changes in precipitation and river discharge) in the valley and defining periods and areas suffering water stress,
- quantification of plants role as a buffering system for the protection of the river water's quality, through analysis of groundwater chemistry in main types of vegetation cover and potential of different species to accumulate phosphorus.
- The use of obtained results for designing river rehabilitation hot-spot areas

In order to meet the aims following tasks were accomplished in the year 2007:
- collection of meteorological data;
- installation of piezometers along plant communities best representing the valley vegetation;
- weekly measurements of ground water level;
- chemical analysis of ground water samples (collected in the summer and autumn);
- estimation of plant biomass along transects;
- phytosocjological analysis of vegetation.

3. Study area, material and methods

Research was conducted along 6 transects located in the Sokolowka River valley. Transects A and B are situated along the section of the river which is to be re-meandered during forthcoming two years. They consist of 6 piezometers each, installed on both sites of the river.
Transects C, D, E and F are localized in 4 different types of vegetation, being representative of other river sections. Transect C consists of 4 piezometers installed on both sites of the Brzoza River (the main Sokolowka tributary), close to a car service center, transects D, E, and F include 3 piezometers each, installed on one site of the Sokolowka River (Fig. 1.).

Measurement of a ground water level started in July and was conducted weekly.
Samples of water for chemical analysis were collected twice – in September and October. The analysis of anion and cation composition was conducted with an ion chromatograph. Total phosphorus and total nitrogen were measured using standard Hatch procedures.
Plant community was analyzed in the field and species cover was estimated according to the Brown Blanquet abundance-dominance scale. Additionally herb layer samples were collected from an area of $1m^2$, situated within 2m distance from each piezometer, in order to identify the herb plant species and assess dry plant biomass.

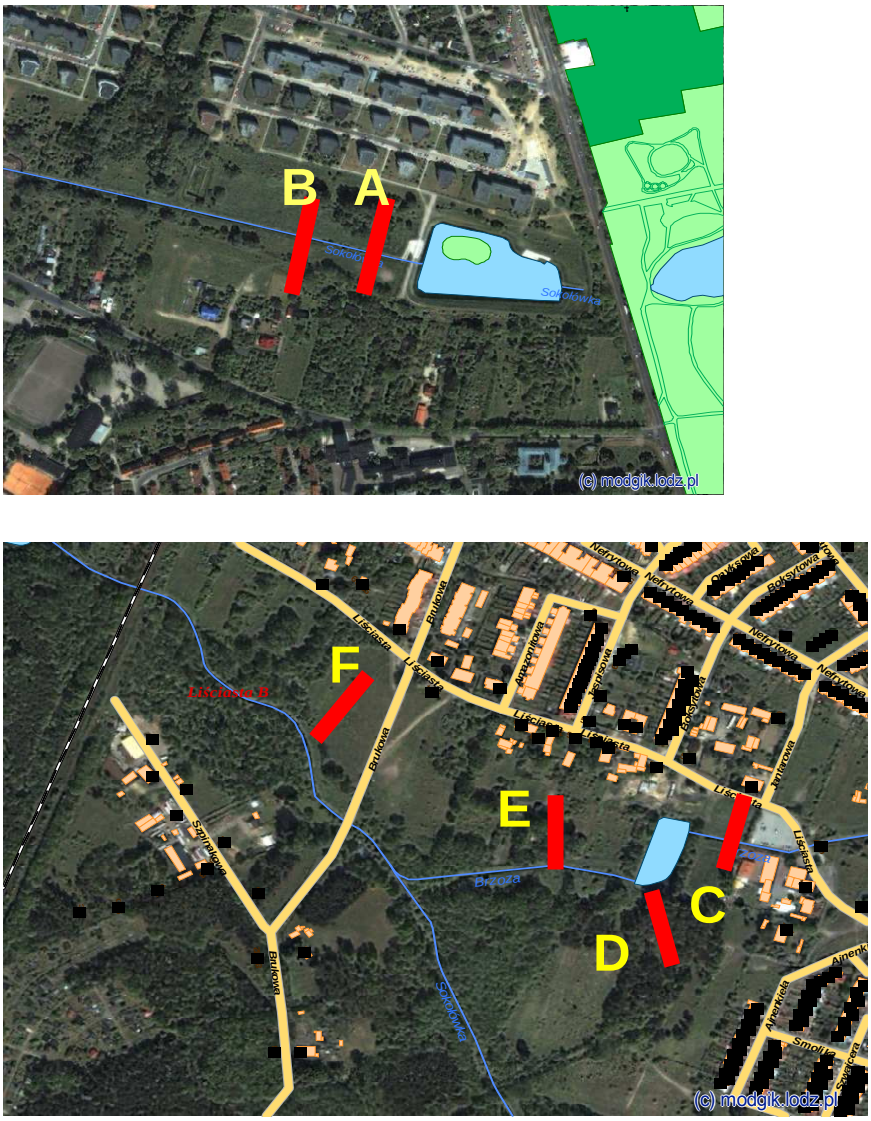

Fig. 1. Location of piezometer transects in the Sokolowka River valley.

4. Results

4.1. Ground water

Discontinuity of observation in case of piezometers A5 and A6 was caused by their removal.

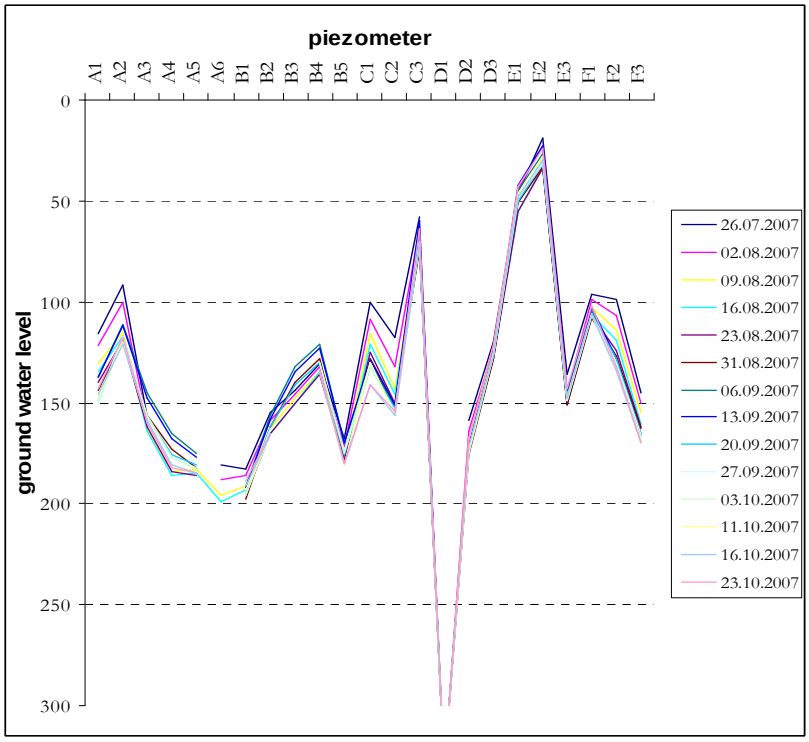

Fig.2. Changes of ground water level in 23 piezometers located in the Sokolowka river valley.

4.2. Phytosociological analysis

Phytosociological evaluation of various study sites along different transects has shown a dominating role of ruderal herb communities in the valley (eg. *Dactylis glomerata-Urtica dioica*, *Solidago canadensis-Urtica dioica*) and occurring of the ruderal forest community (*Betula pendula-Festuca ovina*) and also riverside ash-alder forest *Fraxino-Alnetum* in degeneration form (Tab. 1, Tab. 2-7).
In the summer, biomass production of the herb layer for various sites in the valley reached values between 0,066 – 6460 kg d.w. (dry weight) per ha (Tab. 1).

Tab.1. Distribution of plant communities and relevant biomass values (g dry weight per m2) along piezometer's transects.

Transect	Site	Plant community	Biomass of the herb layer
-	-	-	[g d.w. m^{-2}]
A	1	Ruderal nitrophilous forest community *Populus nigra-Chelidonium majus*	65,8
	2	Grass community with *Calamagrostis epigejos*	419,0
	3	Ruderal community *Dactylis glomerata-Bromus intermis*	340,2
	4	Ruderal community *Dactylis glomerata-Urtica dioica*	-
	5	Ruderal community *Calamagrostis epigejos-Solidago canadensis*	-
	6	Ruderal community *Urtica dioica-Galium aparine*	244,0
B	1	Ruderal community *Solidago canadensis-Urtica dioica*	174,6
	2	Ruderal community *Solidago canadensis-Urtica dioica*	313,3
	3	Ruderal community *Dactylis glomerata-Bromus intermis*	279,3
	4	Ruderal community *Dactylis glomerata-Urtica dioica*	347,0
	5	Ruderal community *Solidago canadensis-Urtica dioica*	453,6
C	1	Ruderal community *Calamagrostis epigejos-Solidago canadensis*	476,0
	2	Ruderal community *Calamagrostis epigejos-Solidago canadensis*	646,0
	3	Ruderal community *Urtica dioica-Galium aparine*	376,1
D	1	Ruderal forest community *Betula pendula-Festuca ovina*	101,4
	2	Ruderal forest community *Betula pendula-Dactylis glomerata*	326,9
	3	Ruderal community *Dactylis glomerata-Bromus intermis*	335,6
E	1	Riverside ash-alder forest *Fraxino-Alnetum*, degeneration form	262,8
	2	Riverside ash-alder forest *Fraxino-Alnetum*, degeneration form	122,5
	3	Riverside ash-alder forest *Fraxino-Alnetum*, juvenile form	132,6
F	1	Ruderal community *Dactylis glomerata-Urtica dioica*	280,5
	2	Ruderal community with *Festuca rubra*, phase of develope brushwood	295,8
	3	Ruderal community *Conyza canadensis-Achillea millefolium*	195,2

Tab.2. Phytosociological evaluation of the sites along transect A (a_1, a_2 – tree layer, b – shrubs, c – herbs).

A-1 Ruderal nitrophilous forest community *Populus nigra-Chelidonium majus*

Layer	**a_1**	**a_2**	**b**	**c**
Populus nigra	2	+	.	.
Quercus robur	1	3	1	+
Sambucus nigra	.	.	2	.
Crataegus monogyna	.	.	2	+
Acer platanoides	.	.	1	2
Euonymus europaea	.	.	.	+
Chelidonium majus				2
Allaria petriolata				2
Aegopodium podagraria				1
Geum urbanum				1
Carex hirta				1
Dactylis glomerata				+
Artemisia vulgaris				+

Urtica dioica	+
A-2 Grass community with *Calamagrostis epigejos*	
Calamagrostis epigejos	5
Tanacetum vulgare	+
Rumex acetosa	+
Urtica dioica	+
A-3 Ruderal community *Dactylis glomerata-Bromus intermis*	
Dactylis glomerata	3
Bromus intermis	3
Phragmites australis	+
Urtica dioica	1
Tanacetum vulgare	+
Solidago canadensis	+
Ranunculus repens	+
A-4 Ruderal community *Dactylis glomerata-Urtica dioica*	
Dactylis glomerata	4
Urtica dioica	2
Tanacetum vulgare	1
Taraxacum officinalis	1
Agrostis stolonifera	1
Bromus intermis	1
Cirsium vulgare	+
Achillea millefolium	+
Conyza canadensis	+
Trifolium repens	+
Leontodon autumnalis	+
Solidago canadensis	+
Galium aparine	+
A-5 Ruderal community *Calamagrostis epigejos-Solidago canadensis*	
Calamagrostis epigejos	4
Urtica dioica	2
Solidago canadensis	1
Cirsium vulgare	+
Taraxacum officinale	+
Galium aparine	+
Bromus intermis	+
Geranium pratense	+
Tanacetum vulgare	+
A-6 Ruderal community *Urtica dioica-Galium aparine*	
Urtica dioica	4
Geum urbanum	1
Potentilla reptans	1
Galium aparine	1
Calamagrostis epigejos	+
Agrostis stolinifera	1
Ranunculus repens	1
Alchemilla sp.	+
Solidago canadensis	+
Conyza canadensis	+
Dactylis glomerata	+

* the Brown Blanquet abundance-dominance scale applied: "+" < 1% of cover; "1" 1-10% of cover; "2" 10-25% of cover; "3" 25-50% of cover; "4" 50-75% of cover; "5" 75-100% of cover.

Tab.3. Phytosociological evaluation of the sites along transect B.

B-1 Ruderal community *Solidago canadensis-Urtica dioica*				
Layer	**a_1**	**a_2**	**b**	**c**

Solidago canadensis	2
Aegopodium podagraria	2
Urtica dioica	2
Dactylis glomerata	2
Dechampsia ceaspitosa	2
Gallium aparine	1
Chelidonium majus	1
Geum urbanum	+
Conyza canadensis	+
Lamium purpureum	+
Oenothera sp.	+
Agrostis stolonifera	+
Ranunculus repens	+
B-2 Ruderal community *Solidago canadensis-Urtica dioica*	
Soidago canadensis	3
Urtica dioica	3
Bromus intermis	+
Cirsium vulgare	+
Galium aparine	+
B-3 Ruderal community *Dactylis glomerata-Bromus intermis*	
Dactylis glomerata	4
Bromus intermis	2
Urtica dioica	1
Ranunculus repens	1
Galium aparine	+
Solidago canadensis	+
B-4 Ruderal community *Dactylis glomerata-Urtica dioica*	
Urtica dioica	3
Dactylis glomerata	2
Galium aparine	2
Bromus intermis	1
Poa pratensis	1
B-5 Ruderal community *Solidago canadensis-Urtica dioica*	
Urtica dioica	5
Solidago canadensis	2
Bromus intermis	1
Galium aparine	1

* the Brown Blanquet abundance-dominance scale applied: "+" < 1% of cover; "1" 1-10% of cover; "2" 10-25% of cover; "3" 25-50% of cover; "4" 50-75% of cover; "5" 75-100% of cover.

Tab.4. Phytosociological evaluation of the sites along transect C.

C-1 Ruderal community *Calamagrostis epigejos-Solidago canadensis*				
Layer	**a_1**	**a_2**	**b**	**c**

Calamagrostis epigejos	4
Solidago canadensis	2
Elymus repens	2
Dactylis glomerata	1
Urtica dioica	+
C-2 Ruderal community *Calamagrostis epigejos-Solidago canadensis*	
Solidago canadensis	5
Calamagrostis epigejos	2
Elymus repens	1
Galium aparine	+
Urtica dioica	+
Holcus lanatus	+
C-3 Ruderal community *Urtica dioica-Galium aparine*	
Urtica dioica	5
Galium aparine	2
Agrostis stolonifera	1
Bromus intermis	+

* the Brown Blanquet abundance-dominance scale applied: "+" < 1% of cover; "1" 1-10% of cover; "2" 10-25% of cover; "3" 25-50% of cover; "4" 50-75% of cover; "5" 75-100% of cover.

Tab.5. Phytosociological evaluation of the sites along transect D.

D-1 Ruderal forest community *Betula pendula-Festuca ovina*				
Layer	**a_1**	**a_2**	**b**	**c**
Betula pendula	3	.	+	+
Padus serotina	.	.	.	+
Festuca ovina				4
Agrostis capillaris				3
Solidago virgaurea				1
Hieracium pilosella				1
Poa compressa				1
Carex pilulifera				+
Anthoxantum odoratum				+
Dantonia decumbens				+
Taraxacum officinale				+
Cytisus ratisbonensis				+
D-2 Ruderal forest community *Betula pendula-Dactylis glomerata*				
Betula pendula	3	.	.	.
Quercus robur		.	1	1
Padus serotina		.	1	1
Frangula alnus		.	1	+
Crataegus monogyna		.	.	+
Dactylis glomerata				3
Agrostis capillaris				2
Geum urbanum				1
Poa compressa				1
Agropyron repens				1
Carex hirta				1
Lysimachia vulgaris				+
Solidago virgaurea				+
Galium aparine				+
Artemisia vulgaris				+
D-3 Ruderal community *Dactylis glomerata-Bromus intermis*				
Bromus intermis				3
Agrostis stolonifera				2
Equisetum arvense				1
Dactylis glomerata				1

Phleum pratense	1
Cirsium arvense	+

* the Brown Blanquet abundance-dominance scale applied: "+" < 1% of cover; "1" 1-10% of cover; "2" 10-25% of cover; "3" 25-50% of cover; "4" 50-75% of cover; "5" 75-100% of cover.

Tab.6. Phytosociological evaluation of the sites along transect E.

E-1/E-2 Riverside ash-alder forest *Fraxino-Alnetum*, degeneration form				
Layer	**a_1**	**a_2**	**b**	**c**
Alnus glutinosa	3	.	.	.
Sambucus nigra	.	.	2	+
Padus serotina	.	.	1	+
Padus avium	.	.	1	+
Acer platanoides	.	.	1	+
Sorbus aucuparia	.	.	+	+
Quercus robur	.	.	.	+
Crataegus monogyna	.	.	.	+
Euonymus europaea	.	.	.	+
Carex acutiformis				3
Aegopodium podagraria				2
Geum urbanum				1
Rubus idaeus				1
Urtica dioica				1
Oxalis acetosella				+
Valeriana officinalis				+
Dechampsia ceaspitosa				+
Humulus lupulus				+
Stellaria nemorum				+
Galium aparine				+
Agrostis stolonifera				+
Solidago canadensis				+
E-3 Riverside ash-alder *forest Fraxino-Alnetum*, juvenile form				
Alnus glutinosa	3	.	+	+
Acer negundo	.	.	+	.
Quercus robur	.	.	.	1
Euonymus europaea	.	.	.	+
Sambucus nigra	.	.	.	+
Prunus cerasifera	.	.	.	+
Crataegus monogyna	.	.	.	+

* the Brown Blanquet abundance-dominance scale applied: "+" < 1% of cover; "1" 1-10% of cover; "2" 10-25% of cover; "3" 25-50% of cover; "4" 50-75% of cover; "5" 75-100% of cover.

Tab.7. Phytosociological evaluation of the sites along transect F.

F-1 Ruderal community *Dactylis glomerata-Urtica dioica*				
Layer	**a_1**	**a_2**	**b**	**c**
Urtica dioica				4

Bromus intermis	4
Phragmites australis	+
Dactylis glomerata	+
F-2 Ruderal community with Festuca rubra, phase of develope brushwood	
Quercus robur . . 2	1
Festuca rubra	3
Dactylis glomerata	2
Elymus repens	2
Urtica dioica	1
Rumex acetosa	1
Taraxacum officinale	1
Plantago lanceolata	1
Equisetum arvense	+
Lamium purpureum	+
Leontodon autumnalis	+
Conyza canadensis	+
Achillea millefolium	+
Alchemilla sp.	+
F-3 Ruderal community *Conyza canadensis-Achillea millefolium*	
Conyza canadensis	2
Achillea millefolium	2
Hypochoeris radicata	2
Berteroa incala	1
Hieracium pilosella	1
Poa angustifolia	1
Rumex acetosa	1
Trifolium arvense	1
Centaurea stoebe	+
Dactylis glomerata	+
Solidago canadensis	+
Urtica dioica	+

* the Brown Blanquet abundance-dominance scale applied: "+" < 1% of cover; "1" 1-10% of cover; "2" 10-25% of cover; "3" 25-50% of cover; "4" 50-75% of cover; "5" 75-100% of cover.

5. Conclusions:

Phytosociological evaluation of the Sokolowka valley has shown the dominating role of ruderal herbs communities and occurring of the ruderal forest community and also riverside ash-alder forest in degeneration form.

The area of the greatest summer herbs biomass production per unit was observed in a ruderal community *Calamagrostis epigejos-Solidago canadensis* (6460 kg d.w. ha^{-1}).

In the summer, in some sections of the Sokolowka valley groundwater level reached 2,5m and below - that requires special attention in the future planning of river re-meandering and establishing green areas. In the valley there were also sections in which the groundwater level oscillated between 0,5-1m and influenced water chemistry (e.g. about 70% reduction of NO_3 within 15m range from the river). Such areas could be recommended as i) buffering zones supporting self-purification of ground and surface waters, ii) areas enhancing water retentiveness, iii) cores of future greens and iv) shelters of urban biodiversity.

6. Next steps

Next steps of the project realization will be: thecontinuation of analysis of chemical parameters of the ground water and their comparison with the chemistry of river water. The dynamic of

ground water levels against precipitation and river discharge data will also be analyzed . Furthermore, nature evaluation and mapping of vegetation of the selected sections valley will be done. The 2008 research is scoped on defining the ability of different vegetation types to accumulate P, N and heavy metals considering contribution of different species and seasonal biomass production, and their role in water circulation. Finally they serve as an identification of the best plant indicators of soil properties – with respect to moisture, fertility and anthropogenic stress, which will facilitate the process of up-scaling the environmental assessment to the whole catchment.

7. Summary

The overall aim of the first year of this research was defining a current status of the Sokolowka River and its valley with special focus on a river-valley connectedness. To achieve the aim ground water monitoring has been set up and the first phase of plant cover valuation has been completed. On the basis of the pilot research the areas have been determined that could potentially be recommended as i) buffering zones supporting self-purification of ground and surface waters, ii) areas enhancing water retentiveness, iii) cores of future greens and iv) shelters of urban biodiversity, but this observation requires further study-ies. (see 6. Next step).