Доклади на Българската академия на науките
Comptes rendus de l'Académie bulgare des Sciences

Tome 66, No 2, 2013

BIOLOGIE

Ecologie

REFERENCE AQUATIC MACROPHYTE COMMUNITIES AT RIVERS IN SOUTHWESTERN BULGARIA

Gana Gecheva, Lilyana Yurukova*

(*Submitted by Academician V. Golemansky on October 8, 2012*)

Abstract

Aquatic macrophytes were studied at nine near-natural river sites together with water chemistry (pH, electrical conductivity, nitrate nitrogen, orthophosphates, total N and P) and physical characteristics (substrate type, shading, flow velocity, mean depth and width). Reference Index reflecting general degradation was applied to assess the ecological quality.

As the reference conditions are represented by minimally-disturbed sites, the study presented innovative approach to assess potentially-impaired sites based on the reference community approach.

Key words: reference macrophyte community, aquatic vascular plants and bryophytes, river types

Introduction. River macrophyte communities are determined by the physical habitat characteristics, water chemistry and anthropogenic impact [1]. As bioindicators they react to alterations by decline in species richness and oligotrophic species. Thus compositional patterns of aquatic macrophytes are sensitive to a number of factors such as water flow velocity and level, eutrophication, pollution and additional pressures. The Water Framework Directive 2000/60/EC [2] requires member states of the European Union to achieve good ecological status by 2015 in all water bodies. Individual water bodies are graded into one of five

The study was carried out under a Contract led by Mr Svetoslav Cheshmedjiev and funded by West Aegean River Basin Directorate.

quality classes (high, good, moderate, poor or bad) reflecting Ecological Quality Ratio (EQR), which evaluates water quality in a score ranging from 0 (worst status) to 1 (reference status). Biological quality elements, among them aquatic flora, are the key parameters on which the assessment is based. High ecological status is thus determined via dominance of reference species in type-specific vegetation density. In recent years, Bulgarian Biotic Index based on invertebrate bottom communities has been developed and tested for Mesta River assessment [3]. Aquatic macrophyte species composition in Bulgarian rivers in relation to environmental variables was studied [4]. Since ecological status is established by comparing the present conditions in water bodies with reference conditions, the aims of this study were to (i) describe reference aquatic macrophyte communities for six river types; (ii) assess the ecological quality of selected river sites; (iii) compare the relationship between physical characteristics and macrophyte abundance, and water chemistry with assessed quality.

Materials and methods. ***Study area and sampling.*** The area of Southwestern Bulgaria (West Aegean River Basin District) was studied (Fig. 1). Nine sampling sites in potential undisturbed conditions, representing six national river types, were selected and macrophyte communities together with river water were

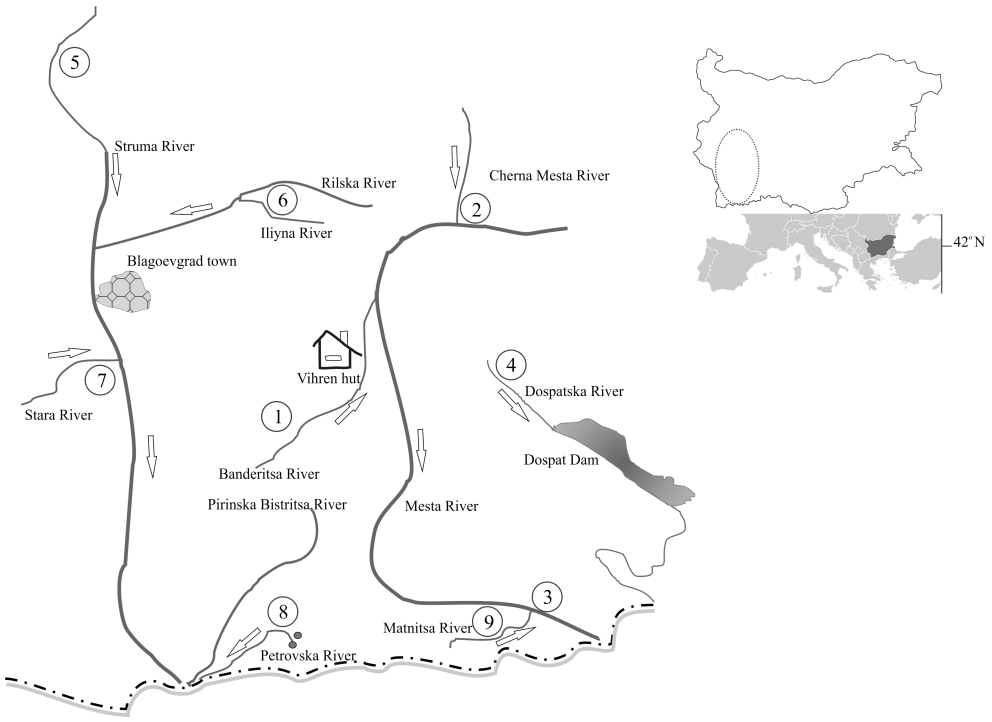

Fig. 1. Studied river sites in Southwestern Bulgaria

observed in 2011. Vascular plants and bryophytes were recorded at each site together with physical characteristics after [5]. The nomenclature followed [6] for liverworts, [7] for mosses and [8–13] for vascular plants. The abundance of each species was noted according to [14]. In situ measurements of acidity (pH) and electrical conductivity (C, µS.cm^{-1}) of river water were done using a Multiline P3 (WTW, Germany). Nitrate nitrogen (N), orthophosphates, total N and phosphorus (P) were analyzed on spectrophotometer NOVA 60 (MERCK), following adopted standards. Reference Index (RI) which defines type-specific reference and non-specific disturbance indicating taxa, and transformation into ecological quality ratio (EQR), was calculated after [5].

Statistical analysis. To determine if significant correlation occured between assessed macrophytes abundance and physical characteristics, and between RI and water chemistry, a multiple regression was applied. Data analyses using STATISTICA 7 for Windows (StatSoft CR) were conducted.

Results and discussion. Forty-eight taxa, among them 16 bryophytes, were recorded (Table 1). *Fontinalis antipyretica* was the most distributed species, typical of mountain sites. Banderitsa River showed maximal value of RI and reference community specific for alpine river type (R1), represented exclusively by

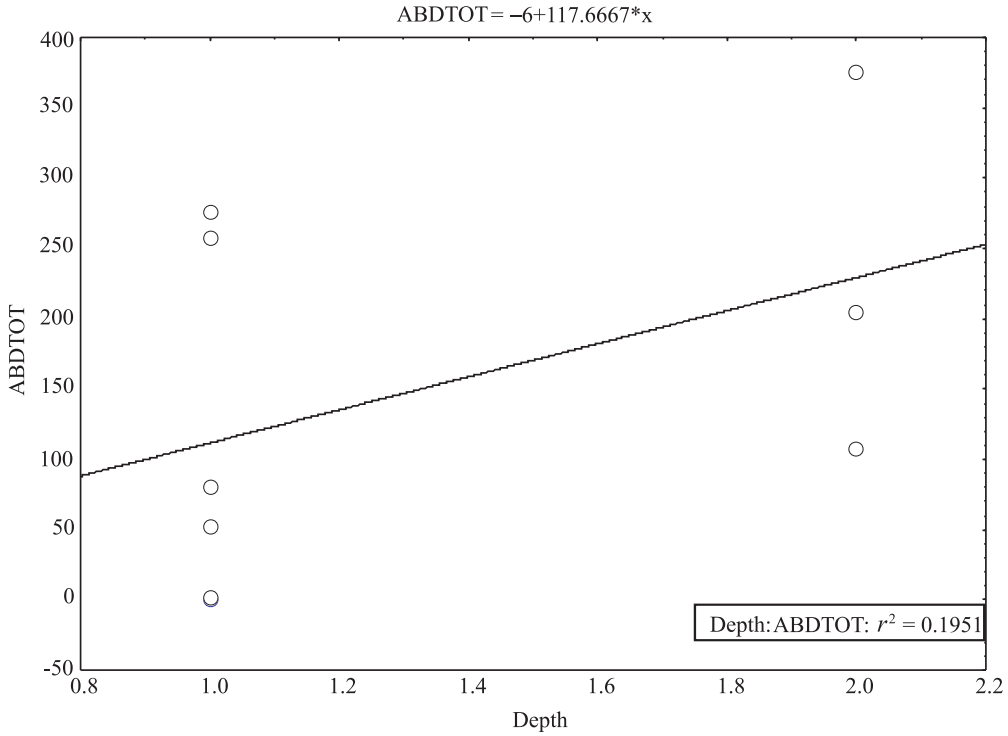

Fig. 2. Correlation between total macrophyte abundance and mean depth

Table 1

Sampling sites, assessed ecological status and registered macrophytes

No	River	Site/Latitude and Longtitude	Altitude a.s.l. [m]	River type	RI	EQR	Taxa
1	Banderitsa	before Vihren Hut 41.756 23.416583	1980	R1	100	1	*Bryum turbinatum* (Hedw.) Turner *Chiloscyphus polyanthos* (L.) Dumort. *Cinclidotus fontinaloides* (Hedw.) P. Beauv.
2	Cherna Mesta	before Cherna Mesta village 42.056389 23.727611	998	R3	0	0.50	*Fontinalis antipyretica* Hedw.
3	Mesta	Ablanitsa village 41.500167 23.931667	423	R5	−97	0.02	*Bidens tripartita* L. *Ceratophyllum demersum* L. *Cyperus fuscus* L. *Leptodictyum riparium* (Hedw.) Warnst. *Myriophyllum spicatum* L. *Persicaria hydropiper* (L.) Opiz *Potamogeton crispus* L. *Ranunculus trichophyllus* Chaix
4	Dospatska	after Pobit kamak village 41.816678 23.90125	1271	R3	−11	0.44	*Alisma plantago-aquatica* L. *Brachythecium campestre* (Müll. Hal.) Bruch, Schimp. & W. Gümbel *Bryum weigelii* Spreng. *Calitriche cophocarpa* Sendtner *Chiloscyphus pallescens* (Ehrh. ex Hoffm.) Dumort. *Cystopteris fragilis* (L.) Bernh. *Equisetum arvense* L. *Fontinalis antipyretica* Hedw. *Galeopsis bifida* Boenn. *Juncus bufonius* L. *Juncus effusus* L. *Lysimachia nummularia* L.

Table 1. Continued

							Marchantia polymorpha L. *Mentha spicata* L. *Ranunculus flammula* L. *Ranunculus ophioglossifolius* Vill. *Sparganium erectum* L. *Sphagnum* sp.
5	Struma	before Razhdavitsa village 42.387944 22.706278	485	R5	58	0.79	*Berula erecta* (Huds.) Coville *Cyperus longus* L. *Galium palustre* L. *Leptodictyum riparium* (Hedw.) Warnst. *Mentha aquatica* L. *Mentha spicata* L. *Persicaria lapathifolia* (L.) S. F. Gray *Ranunculus repens* L. *Schistidium rivulare* (Brid.) Podp. *Sparganium erectum* L. *Veronica beccabunga* L.
6	Iliyna	before inflow into Rilska River 42.109778 23.324639	940	R3	64	0.82	*Chiloscyphus pallescens* (Ehrh. ex Hoffm.) Dumort. *Fontinalis antipyretica* Hedw. *Marchantia polymorpha* L. *Petasites albus* (L.) Gaertn. *Platyhypnidium riparioides* (Hedw.) Dixon
7	Stara	before Zheleznitsa village 41.922806 23.097778	329	R14	80	0.90	*Bryum schleicheri* DC. *Chiloscyphus polyanthos* (L.) Dumort.
8	Petrovska	after karst spring 41.416167 23.55	650	R15	50	0.75	*Cinclidotus aquaticus* (Hedw.) Bruch & Schimp. *Equisetum palustre* L. *Palustriella decipiens* (De Not.) Ochyra *Pedinophyllum interruptum* (Nees) Lindb.

Table 1. Continued

9	Matnitsa	bridge for Petrelik village 41.484556 23.865528	473	R13	−1	0.50	*Berula erecta* (Huds.) Coville *Bidens tripartita* L. *Cyperus fuscus* L. *Cyperus longus* L. *Echinochloa crus-galli* (L.) Beauv. *Epilobium parviflorum* Schreb. *Juncellus serotinus* (Rottb.) G. B. Clarke *Juncus effusus* L. *Mentha aquatica* L. *Persicaria mitis* (Schrank) Opiz *Petasites albus* (L.) Gaertn. *Veronica beccabunga* L.

bryophytes. Among the three studied mountain sites, Cherna Mesta River was evaluated as unrepresentative due to habitat physical characteristics (mainly substrate and high flow velocity). On the contrary, Dospatska River was with highest species diversity. Macrophyte community was characterized by species typical of lowland rivers, indicators of moderate organic load: *Ranunculus ophioglossifolius*, *R. flammula*, *Cystopteris fragilis*, *Calitriche cophocarpa*. This observation suggests that the river section is a specific case of mountain river type, i.e. slow-moving, meandering, sandy stretch. The last mountain site at Iliyna River was in high ecological status. At the semi-mountain site along Mesta River, no representatives of type-specific reference community were found, instead of species, typical of altered eutrophic conditions (*Ceratophyllum demersum*, *Potamogeton crispus*). The second semi-mountain sampling site at Struma River was with high species diversity and status. The deviation between the reference macrophyte community found on the undisturbed river stretch in comparison with the community detected along Mesta River was clear. The macrophyte community at Matnitsa River (R13 – small and medium floodplain rivers) lacked exclusively aquatic species and was rich in hydrophytes, helophytes and amphiphytes. Only two scattered bryophytes were recorded at the sub-Mediterranean site along Stara River. Bryophytes dominated the community at Petrovska River with cover above 50%. A few species typical of highly selective karst habitat were registered.

The coefficient of determination (R^2) obtained in the regression analysis of macrophyte abundance per site against the physical charateristics was 0.75. Strongest positive relationship was found with mean depth (Fig. 2), followed by shading (B coefficient 0.70 and 0.57 respectively). Strongest negative correlation

was established with velocity (B coefficient -0.64). The coefficient of determination was 0.59 in the analysis of RI and water chemistry. The reference Index was negatively correlated mainly with total P and N (B coefficient -5.8 and -4.4).

Conclusions. First attempt was presented to describe macrophyte development in pristine river stretches in Southwestern Bulgaria and to reveal the variation in community structure among various stream types. In the majority of river sites, aquatic macrophytes may be considered as type-representative reference communities. Nevertheless, in several cases reference site selection or type characteristics must be reconsidered, for example, Mesta and Dospatska River stretches. Minimally affected by human stressors and alterations were alpine and karst spring river sites.

The recognition of type-specific macrophyte reference communities for six national river types is significant, since in Europe undisturbed representative aquatic ecosystems are rare. Further studies are needed to confirm the achieved results. This preliminary study is also a base for restoration and remediation measures for the river sites that were not in good status.

REFERENCES

[1] Birk S., N. Willby. Hydrobiologia, **652**, 2010, 149–163.

[2] European Union. Off. J. Euro. Commun., **L 327**, 2000, 1–72.

[3] Soufi R., E. Varadinova, Y. Uzunov. Compt. rend. Acad. bulg. Sci., **57**, 2004, No 8, 83–86.

[4] Gecheva G., L. Yurukova, S. Cheshmedjiev. Turk. J. Bot., **37**, 2013, 99–110.

[5] Schaumburg J., C. Schranz, J. Foerster, A. Gutowski, G. Hofmann, P. Meilinger, S. Schneider, U. Schmedtje. Limnology, **34**, 2004, 283–301.

[6] Grolle R., D. G. Long. J. Bryol., **22**, 2000, 103–140.

[7] Hill M. O., N. Bell, M. A. Bruggeman-Nannenga, M. Brugués, M. J. Cano, J. Enroth, K. I. Flatberg, J.-P. Frahm, M. T. Gallego, R. Garilleti, J. Guerra, L. Hedenäs, D. T. Holyoak, J. Hyvönen, M. S. Ignatov, F. Lara, V. Mazimpaka, J. Muñoz, L. Söderström. J. Bryol., **28**, 2006, No 3, 198–267.

[8] Flora of the Republic of Bulgaria (eds D. Yordanov, B. Kuzmanov), Sofia, Print. House of the Bulgarian Academy of Sciences, **III**, 1966, 637 (in Bulgarian).

[9] Flora of the Republic of Bulgaria (eds D. Yordanov, S. Kozhuharov), Sofia, Print. House of the Bulgarian Academy of Sciences, **IV**, 1970, 748 (in Bulgarian).

[10] Flora of the Republic of Bulgaria (ed. B. Kuzmanov), Sofia, Print. House of the Bulgarian Academy of Sciences, **VII**, 1979, 529 (in Bulgarian).

[11] Flora of the Republic of Bulgaria (ed. V. Velchev), Sofia, Print. House of the Bulgarian Academy of Sciences, **VIII**, 1982, 518 (in Bulgarian).

[12] Flora of the Republic of Bulgaria (ed. B. Kuzmanov), Sofia, Print. House of the Bulgarian Academy of Sciences, **IX**, 1989, 539 (in Bulgarian).

[13] Flora of the Republic of Bulgaria (ed. S. Kozhuharov), Sofia, Print. House of the Bulgarian Academy of Sciences, **X**, 1995, 428 (in Bulgarian).
[14] Kohler A. Landschaft & Stadt, **10**, 1978, No 2, 73-85.

Faculty of Biology
University of Plovdiv
24, Tsar Assen Str.
4000 Plovdiv, Bulgaria
e-mail: ggecheva@mail.bg

**Institute of of Biodiversity and Ecosystem Research*
Bulgarian Academy of Sciences
Base 3, Acad. G. Bonchev Str., Bl. 23
1113 Sofia, Bulgaria
e-mail: yur7lild@bio.bas.bg