Oceanological and Hydrobiological Studies

International Journal of Oceanography and Hydrobiology

Volume 44, Issue 2, June 2015
pages (273-281)

ISSN 1730-413X
eISSN 1897-3191

Composition and seasonal changes in filamentous algae in floating mats

by

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DOI: **10.1515/ohs-2015-0026**
Category: **Short communication**
Received: **January 8, 2015**
Accepted: **March 3, 2015**

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Abstract

The occurrence of algal-cyanobacterial metaphyton mats in field (Konojad village) and artificial ponds (Poznań city) was investigated in the Wielkopolska region. The surface area of algal mats ranged between ca. 45% (natural pond) and 10% (artificial pond) of the total water surface, and the mats occurred from the water surface to the bottom; the algal diversity was similar in both types of ponds, i.e. about 10 taxa. The most frequently recorded and dominant taxa in small water bodies were: *Spirogyra* spp., *Cladophora fracta* in the artificial pond and *Oedogonium* spp., *Cladophora rivularis* in the natural pond. The dynamics of macroalgae demonstrated a pattern comprising different phases of taxa dominance. For example, April regarded as the first phase was characterized by a small amount of metaphyton, represented by *Tribonema* and *Ulothrix* taxa. In May, these species disappeared and were replaced by: *Oedogonium* spp. and *Cladophora* spp. which formed large aggregations in the field pond, and *Spirogyra* spp. which abundantly proliferated in the artificial pond. From June, however, *Oedogonium* and/or *Cladophora* significantly dominated in the mat structure and at the same time covered a large area of the water surface. The algal community was dominated by common algal taxa, among which single filaments of other taxa could also occur.

Key words: macroalgae, filamentous algae, metaphyton mats, small water bodies, seasonal dynamics, *Cladophora*

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Introduction

Metaphyton is a community composed of filamentous forms of algae forming frequently floating mats, which include *Cladophora, Hydrodictyon, Rhizoclonium, Spirogyra, Mougeotia, Vaucheria, Ulva* (*Enteromorpha*) and *Oedogonium* species (Wetzel 2001, Pieczyńska 2008, Mareš et al. 2011). Cyanobacteria can also occurs in the metaphyton community (Hillebrand 1983, Scheffer 2001, Zohary et al. 1998). The term "metaphyton" has several synonyms like flab, pseudoplankton or pond scum (Zohary et al. 1998). Mats of green macroalgae can be characteristically organized in terms of (i) the species composition and species diversity because they can be single- or multi-species, (ii) the structure – patches can be very sparse or dense, and (iii) the area covered (Saunders et al. 2012, Pikosz 2012). Metaphyton may have varied origin, such as: epiphyton, epipelon and epilithon (Stewenson 1996, Poulíčková 2008). Filamentous green algae can co-exist with submerged macrophytes or occur alone (Pieczyńska 2008, Lembi 2000). Traits such as: a filament form, a wide ecological range of filamentous green algae causes that these algae growth rapidly and form massive blooms (Margalef 1983, Cambra & Aboal 1992). *Spirogyra* and *Cladophora* may triplicate their biomass in only three days (Cambra & Aboal 1992), while a high level of nutrients stimulate massive growth of *Ulva* (Messyasz et al. 2012). According to Hillebrand (1983), the dominance of filamentous algal species can change during a season as habitat conditions change; for example *Cladophora glomerata* (L.) Kütz. prefers high N and P concentration (Borchardt 1996), *Mougeotia* sp. tolerates a wide range of pH (Turner et al. 1987).

It is also important to mention the role of metaphyton mats in the functioning of aquatic ecosystems, including mainly shading which reduces the phytoplankton growth (Graham et al. 1995); filamentous species are food for grazers (Graham et al. 1996) as well as refuge for zooplankton (Scheffer 2001). Moreover, dead biomass of macroalgae can cause anaerobic conditions due to the use of oxygen during their decomposition near the bottom. In small and shallow ponds, there are right conditions for filamentous algae growth. Stagnant water, limited wave action and movement are the factor that favor algae development. High levels of nutrients, especially phosphorus and nitrogen play a crucial role in the growth of algae. According to Scheffer et al. (2006), shallow ponds are characterized by high species richness and high biodiversity. The majority of scientific works documenting the flora of the littoral zone of different water bodies provide information on the presence of filamentous algae. Most often, however, the information refers only to the mere fact that smaller or larger patches consisted of filamentous algae without providing a description of the species composition. When it comes to the determination of the composition of macroalgae communities, usually the taxonomic identification is limited to genera and easily identifiable green algae, such as *Ulva* (*Enteromorpha*) and *Cladophora*. This state of affairs makes it difficult to study the geographical distribution of individual filamentous algae species in Poland and very often makes it impossible to describe their precise trophic and ecological characteristics. Although factors (e.g. nutrient status) responsible for macroscopic algae occurrence in aquatic ecosystems are rather well characterized, it is difficult to predict the annual recurrence of mats and the structure of their species. Therefore, it is of special interest to obtain data on the taxonomic and morphological diversity of metaphyton algae taking into account their seasonal pattern and distribution. For this study, small water bodies were selected as having a well-developed littoral zone where floating mats of macroalgae were observed.

The metaphyton in ponds is one of the richest and most heterogeneous areas regarding the filamentous Chlorophyta and Cyanobacteria (Pieczyńska 2008, Stewenson 1996), but there are still many gaps in our knowledge about particular algal species, especially in terms of their seasonal changes and phenology. Thus the main aim of this study was to present the seasonality of macroalgae which occurred in the form of dull green mats floating on the surface of two small ponds of different origin (< 1 ha). The examples were supplemented with basic physicochemical analyses of water.

Materials and methods

Description of the study area

The research on metaphyton collected from small water bodies (0.02-1.0 ha) in the Wielkopolska region was conducted in April-September 2013 in Konojad pond and May-September 2013 in Poznań pond (Table 1, Fig. 1). Sampling sites were located near the shoreline, overgrown with macrophytes in both ponds. During the fieldwork, submerged macrophytes covered approximately 70% of the bottom area of the ponds and emergent vegetation occurred along the entire shoreline. Samples of filaments were collected from a site overgrown with *Ceratophyllum demersum* L., *Phragmites communis* (Cav.) Trin. ex Steud., *Typha angustifolia* L., *Schoenoplectus* (Rchb.) Palla., *Potamogeton natans* L., *Lemna minor* L., *Alisma plantago-aquatica* L., *Sparganium emersum* L., *Rorippa amphibian* (L.) Besser and *Oenanthe aquatica* (L.) Poir.

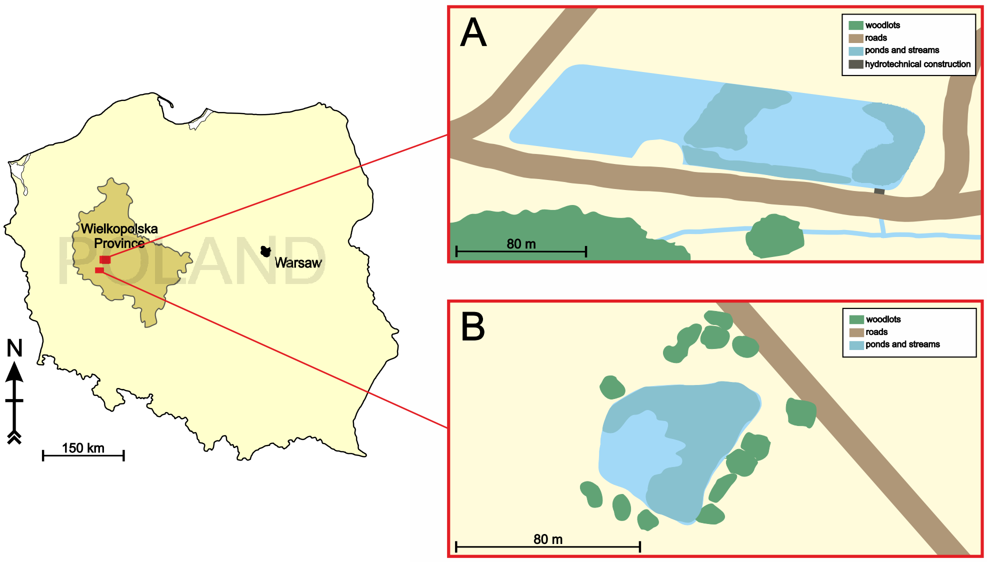

Figure 1

The location of sampling sites in the Wielkopolska region: A – the pond in Poznań; B – the pond in Konojad

Sampling methods

Macroscopic green algae filaments and water samples were collected from the pond in Konojad about three times per month (17 samples of algae and water) and two time per month from the pond in Morasko-Poznań (10 samples of algae and water). The filamentous samples of free-floating green algae (like watt) were collected from the water surface and put into a plastic container with water coming from the same habitat in the ratio of 3:1, and transported to a laboratory. Next, the filaments were rinsed with distilled water to separate any abiotic particles attached to them. In addition to algae collection, measurements of basic physical and chemical properties of water, such as temperature (°C), pH, dissolved oxygen (%), electrolytic conductivity (μS cm^{-1}) and the total dissolved substance (mg l^{-1}) were included in the habitat analysis. These parameters were measured using a YSI Professional Plus probe. Chemical analysis of water was completed with measurements of ammonium (mg l^{-1}), nitrate (mg l^{-1}) and phosphates (mg l^{-1}) in a laboratory using a spectrophotometer HACH DR2800.

Table 1

Main information concerning locations and morphometric characteristics of research ponds

Type of pond	Location	Coordinaties	Surface area	Max depth	Max length	Max width	Bottom
			ha	m			
midfield	village, Konojad	N52˚10'14.17" E16˚31'24.51"	~0.3	1.5	82	47	mud
artificial	city, Poznań	N52°27'52.8" E16°55'25.62"	~0.2	2.2	165	20	mainly concrete

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Microscope identification

Microscopic slides with fresh algal filaments for the identification of taxa were examined using a light microscope (200×, 400×) with a built-in camera, taking into account the shape and composition of cells including the number of pyrenoids (staining Lugol's solution) and nuclei (acetocarmine stain). Taxonomical analysis was also based on morphological features: the shape and the length of thalli, branching, the shape and the size of cells and thalli color. The obtained results related to characteristic features of macroalgae were then compared with morphometric data included in the identification keys of Starmach (1972), Mrozińska (1982), Kadłubowska (1972), Pliński and Hindák (2012).

Proportion of taxa

Proportions of taxa were based on the determination of a percentage of filaments in the dry weight. First, portions of macroalgae were exposed to the drying process at 95°C for 3 hours. Next, 1 g of dry samples was weighed. These samples of filamentous algae have again been put in distilled water. A stereoscopic microscope was used to determine which types of filaments were dominant and which were rare in a sample. (This process was repeated 10 times). During the analysis of samples, the percentage of algae was qualitatively monitored according to a simple rank-scale: (0) none – 0%; (1) rare – 1-10%; (2) common – 11-30%; (3) abundant – 31-70%; (4) highly abundant – 71-100% provided by Schories (1995).

Results

Environmental characteristic of metaphyton habitats

The studied ponds greatly varied in terms of habitat characteristics. For example, the pH value varied in the range from 7.73 to 10.16 in the Konojad pond and from 8.1 to 8.75 in the pond in Poznań. The highest pH value was recorded in July and August. Whereas, values of conductivity ranged from 870 to 1414 μS cm^{-1} in the natural pond and from 225 to 475 μS cm^{-1} in the artificial pond. The obtained data indicate that TDS and EC values were higher in the pond in Konojad than in the pond in Poznań. The water depth at the sampling sites in the ponds does not exceed 1 m. Filamentous algae were found in the water rich in biogenic compounds (Table 2).

Taxonomic and morphological diversity of metaphyton algae

Metaphyton collected from two ponds (Fig. 1) during the fieldwork was mostly multialgal, dense and was present in the water from spring thawing till autumn. During that time, a minimum of two and a maximum of 8 taxa were observed in the mat structure. In the field pond, macroalgal mats covered a larger part of water surface (~45%) than in the artificial water body (up to 2 m from the shoreline). Some of the metaphyton algae, especially *Oedogonium* taxa with a basal cell came from epiphyton, whereas *Cladophora* spp. was floating on the water surface after detachment from the bottom. Metaphyton was characterized by the dominance of filamentous green algae rather than cyanobacteria. Macroalgal mats in the natural pond consisted mainly of Cladophorales and Oedogoniales, while in the artificial pond – Cladophorales and Zygnematales.

Twelve genera of metaphyton belonging to the phyla: Cyanobacteria (*Lyngbya, Spirulina*), Chlorophyta (*Cladophora, Oedogonium, Chaetophora, Cylindrocapsa*), Charophyta (*Ulothrix, Spirogyra, Sirogonium, Zygnema, Mougeotia*) and Ochrophyta (*Tribonema*) were identified in all samples from the two small ponds in the Wielkopolska region (Table 3). Out of the identified taxa, five occurred in both ponds: *Ulothrix variabilis, Tribonema aeuquale, Oedogonium* spp., *Spirogyra* spp. and *Mougeotia* sp. However, *Lyngbya hieronymusii*, *Tribonama vulgare*, *Cylindrocapsa geminella*, *Chaetophora* sp., *Cladophora rivularis* and *Cladophora globulina* were recorded only in the small field pond. Taxa such as *Spirulina* sp., *Zygnema* sp., *Sirogonium* sp. and *Cladophora fracta* were found only in the artificial pond.

Metaphyton algae were also subjected to morphological analysis based on features such as: life form, thalli color, shape and width of filaments and cells, shape and number of pyrenoids, the presence of nucleus, characteristics of chloroplasts and cell wall. Metaphyton from the studied ponds consisted

Table 2

Seasonal variability of physical and chemical parameters [minimum-maximum (standard deviation)] at sampling sites in Konojad and Poznań ponds in 2013

	Temperature (°C)	pH	Oxygen Saturation (%)	Electrolytic Conductivity (µS cm^{-1})	Total Dissolved Substance (mg l^{-1})	N-NO$_3$ (mg l^{-1})	N-NH$_3$ (mg l^{-1})	P-PO$_4$ (mg l^{-1})
	Konojad pond							
April (n=3)	16.1-18.4 (0.7)	8.00-9.10 (0.40)	70-120 (16)	940-1410 (218)	510-703 (74)	0.3-0.5 (0.08)	0.15-0.65 (0.16)	0.31-0.42 (0.04)
May (n=3)	14.8-22.4 (3.4)	8.10-8.60 (0.20)	103-148 (20)	870-1414 (243)	432-706 (122)	0.1-0.6 (0.20)	0.97-1.57 (0.27)	0.16-0.56 (0.17)
June (n=3)	18.9-23.3 (1.5)	8.58-9.77 (0.4)	90-148 (19)	916-1061 (47)	455-530 (24)	0.1-0.3 (0.06)	0.61-1.76 (0.48)	0.18-1.18 (0.33)
July (n=3)	20.9-29.4 (4.5)	8.88-10.16 (0.53)	53-132 (37)	795-1025 (116)	402-511 (57)	0.2-0.2 (0.00)	0.34-0.84 (0.25)	0.09-0.32 (0.09)
August (n=3)	23.4-27.2 (1.5)	8.92-10.05 (0.37)	48-140 (28)	942-985 (13)	478-598 (39)	0.1-0.2 (0.04)	0.24-1.31 (0.35)	0.14-0.28 (0.04)
September (n=2)	18.4-18.8 (0.3)	7.73-9.54 (1.28)	85-99 (10)	912-932 (14)	523-531 (6)	0.1-0.1 (0.00)	0.24-0.42 (0.14)	0.17-0.39 (0.15)
	Poznań pond							
April	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
May (n=2)	23.2-23.6 (0.28)	8.45-8.59 (0.09)	102-109 (5)	286-323 (26)	143-161 (13)	0.2-0.3 (0.07)	0.06-0.16 (0.07)	0.19-0.35 (0.11)
June (n=2)	19.2-20.1 (0.63)	8.3-8.35 (0.03)	86-99 (9)	309-368 (41)	154-184 (21)	0.3-0.3 (0.00)	2.0-2.86 (0.60)	0.12-0.33 (0.15)
July (n=2)	19.5-26.0 (3.50)	8.42-8.61 (0.10)	65-91 (13)	225-475 (142)	112-241 (73)	0.4-0.7 (0.15)	0.08-0.16 (0.04)	0.06-1.02 (0.50)
August (n=2)	26.3-27.5 (0.84)	8.44-8.75 (0.21)	82-111 (20)	369-471 (72)	183-238 (39)	0.1-0.7 (0.42)	0.16-0.23 (0.04)	0.06-0.06 (0.00)
September (n=2)	27.5-28.5 (0.70)	8.1-8.6 (0.35)	58-103 (32)	364-435 (50)	186-217 (22)	0.3-0.4 (0.07)	0.07-0.11 (0.02)	0.13-1.18 (0.74)

n.d. - no data

mainly of filamentous blue-green and green algae. Some of them were branched such as *Cladophora* spp. and *Chaetophora* sp. (Table 4). However, different filament color plays an important role because *Oedogonium* were bright green contrary to usually mat dark-green *Cladophora*.

Seasonal pattern of metaphyton

According to our data, the filamentous algae population in the examined aquatic ecosystems is characterized by seasonal changes. The pattern of macroalgae dynamics consisted of phases. The first phase with low abundance of metaphyton was

Table 3

Composition of metaphyton communities appearing in ponds (Wielkopolska region) during the samples collection

Taxonomic Composition		
Taxon	Konojad pond	Poznań pond
Lyngbya hieronymusii Lemm.	+	-
Spirulina sp. Turpin ex Gomont	-	+
Ulothrix variabilis Kütz. 1849	+	+
Tribonema aeuquale Pascher 1925	+	+
Tribonema vulgare Pascher 1923	+	-
Cylindrocapsa geminella Wolle 1887	+	-
Chaetophora sp. Schrank 1798	+	-
Oedogonium spp. Link 1820	+	+
Cladophora rivularis (L.) Van Hoek 1963	+	-
Cladophora globulina (Kütz.) Kütz. 1845	+	-
Cladophora fracta (Müller ex Vahl) Kütz. 1843	-	+
Mougeotia sp. Agardh 1824	+	+
Zygnema sp.Agardh 1824	-	+
Spirogyra spp. Link 1820	+	+
Sirogonium sp. Kütz. 1843	-	+

Table 4

Morphological characteristic of metaphyton taxa found in mats in both ponds

Morphological Composition

Cyanobacteria

Taxon	No. nucleus	life form	mean width (μm)	reproduction	other
Lyngbya hieronymusii	0	simple filament	13	hormogonia	n.d.
Spirulina sp.	0	spiral filament	1-2	no akinetes	n.d.

Chlorophyta

Taxon	type of filament	shape of chloroplast	pyrenoids (μm)	nucleus (μm)	cell width (μm)	cell shape	other
Cylindrocapsa geminella	unbranched, 25 μm long	1, star-shape	1	n.d.	13-17	elliptic	thick layered membrane, basal holdfast
Chaetophora sp.	branched, tapering	parietal	2-3	n.d.	6-7	circular	one pyrenoids
Oedogonium spp.	unbranched	reticulated	3-7	5-6	19-42	cylindrical	one nucleus in the central part of cell
Cladophora rivularis	branched	parietal	5-8, discoid	5-6	38-120	cylindrical	many nuclei in the cell, dark green
Cladophora globulina	branched	parietal	2-3	2-5	18-26	cylindrical	many nuclei in the cell
Cladophora fracta	branched	parietal	3-6	2-4	20-31	cylindrical	many nuclei in the cell, light green

Charophyta

Taxon	nucleus	shape of chloroplast	cell width (μm)	pyrenoids (μm)	apical cell	other
Mougeotia sp.	1, in the central part	plate- like	25-36		rounded	pyrenoids in one row
Zygnema sp.	1, in the central part	two star-shape	65-68	3-4	rounded	one pyrenoids in the centre
Spirogyra spp.	1, in the central part	ribbon-like, spiral	28-76	4-6	rounded	spiral chromatophor with pyrenoids
Sirogonium sp.	1, in the central part	ribbon-like, simple	60-70	3-5	rounded	spiral chromatophor with pyrenoids
Ulothrix variabilis	1, in the central part	quadratic plate, parietal	2.5-4-6	1-2	rounded	cylindrical cells, one pyrenoid

Ochrophyta

Taxon	nucleus	shape of chloroplast	cell width (μm)	pyrenoids	other
Tribonema vulgare	n.d.	parietal	7-13	absence	H-shape cell, note empty cell on the end, cylindrical cell
Tribonema aeuqale	n.d.	3-4, tear-like	6-8	absence	

n.d. - no data

dominated by *Tribonema* and *Ulothrix* species in April, which co-existed with species from the order Zygnematales (Table 5). In the next phase, from May to August, these species almost disappeared and were replaced by *Cladophora* spp. and *Oedogonium* sp. which formed large blooms in the field pond. Subsequently, from August, *Cladophora rivularis* and *Oedogoniums* sp. dominated and covered a large area of the water surface.

In the artificial pond (Poznań-Morasko), the metaphyton community was represented by Zygnematales (*Spirogyra* sp. *Mougeotia* sp. and *Zygenma* sp.) which were common in May and June. *Spirogyra* taxa were most common in this pond during the research and were represented by four taxa. *Oedogonium* sp. and *Cladophora fracta* dominated from July (Table 5).

DISCUSSION

Environmental characteristics of metaphyton habitats

The range and characteristics of metaphyton in Poland are poorly investigated, but our knowledge about the distribution and ecology of macroalgae mats advances every year. Metaphyton, more often than planktonic algae, contributes to the high biomass concentration, which reduces light penetration through the water column in shallow aquatic ecosystems like lakes or ponds. It is very common that filamentous green algae occurred with communities of macrophytes in the littoral zone in lakes and in small water bodies (Pieczyńska 2008). According to Pieczyńska (2008), floating

Table 5

Time changes in the filamentous algae distribution in ponds in Konojad village and Poznań city in 2013

	April	May	June	July	August	September
	Konojad pond					
Lyngbya hieronymusii	1	1	0	1	1	1
Ulothrix variabilis	3	1	0	0	0	0
Tribonema aequale	2	0	0	0	0	0
Tribonema vulgare	2	0	0	0	0	0
Cylindrocapsa geminella	0	0	0	0	0	0
Chaetophora sp.	1	0	0	0	0	0
Oedogonium spp.	0	3	2	2	3	3
Cladophora rivularis	0	3	4	4	3	3
Cladophora globulina	0	1	1	1	0	0
Mougeotia sp.	1	0	0	0	0	0
Spirogyra spp.	1	1	0	1	0	0
	Poznań pond					
Spirulina sp.	n.d.	1	0	0	0	0
Ulothrix variabilis	n.d.	1	0	0	0	0
Tribonema aequale	n.d.	1	0	0	0	0
Oedogonium spp.	n.d.	0	0	1	2	2
Cladophora fracta	n.d.	0	0	2	3	4
Mougeotia sp.	n.d.	2	2	1	0	0
Zygnema sp.	n.d.	2	2	1	0	0
Spirogyra spp.	n.d.	4	3	1	1	1
Sirogonium sp.	n.d.	1	0	0	0	0

- n.d. - no data,

- Darker background –dominant and sub-dominant taxon in metaphyton community;

- The percentage of algae were qualitatively monitored according to a scale: (0) 0%; (1) 1–10%; (2) 11–30%; (3) 31–70%; (4) 71– 100%.

mats may replace macrophytes, however, during our study, the occurrence of vascular plants in ponds did not change significantly. The massive blooms of filamentous green algae were observed in alkaline ponds, although *Zygnematales* and *Oedogonium* prefer pH >7 (eg. *Spirogyra* 8.4-8.6) but *Cladophora* become more dominant in neutral pH (Fairchild et al. 1989). Our study indicates that a more frequent occurrence of Zygnematales in the artificial pond compared to the field pond may be associated with the water alkalinity which was in the range of 8.1-8.7. Furthermore, Khanum (1982) considers that *Oedogonium* occurred in waters rich in dissolved O_2 (from 8.0 to 10.0 mg l^{-1}). As it follows from the obtained data, oxygen conditions for the *Oeodgonium* development were more optimal in the natural pond (6.5-12.5 mgO_2 l^{-1}). The studied ponds were considerably different from each other in terms of the total dissolved substance – significantly higher values of TDS were recorded in Konojad pond. According to Khanum (1982), *Cladophora* formed mats consisting of one species in water with high dissolved organic matter.

Taxonomic and morphological diversity of metaphyton algae

The knowledge of filamentous algae from Poland, particularly the genera of *Oedogonium* (104 taxa), *Spirogyra* (321 taxa), *Mougeotia* (117 taxa), *Zygnema* (120 taxa) and *Cladophora* (22 taxa and 4 varietas), comes from a few sources (Scheffer et al. 2006, Mrozińska 1982, 1991). In Poland we know only 16 taxa of *Sirogonium* (Mrozińska 1982). In these small ponds, we observed five different filaments of *Spirogyra*, two filaments of *Oedogonium* and three taxa of *Cladophora*. Among the remaining genera of algae, only one representative was recorded. Although filamentous algae are common and macroscopically visible, they are poorly researched and the presence of these species in aquatic ecosystems is only mentioned in the literature. This is a problem resulting from difficulties with taxonomic identification, because the systematics is based on morphological features, mainly the shape and the size of oogonium and antheridium (generative cells). Similarly as in the case of *Oedogonium* where only in a few cases the name of species may be determined based on features of vegetative cells (Starmach 1972). In the samples collected from the studied habitat, only vegetative cells were observed. During the microscopic examination, it was possible to observe differences in the shape and size of pyrenoids, nuclei and chloroplasts. According to Power et al. (2009), different colors of macroalgae depend on: (i) the dominant taxa, (ii) temporal changes in their physiological states, and (iii) ecological succession and the environment.

The main structural part of the examined mats is *Cladophora rivularis* in the natural pond and *Cladophora fracta* in the artificial pond. Other types of green and blue-green algae, except *Oedogonium*, were tangled with *Cladophora* filaments. This fact confirms the literature data, which indicate the occurrence of primarily monospecies algal mats (formed by *Cladophora*) or a few patches consisting of several species such as *Oedogonium* sp. and *Spirogyra* sp. (Khanum 1982). According to literature, *Spirogyra* rarely occurs with *Oscillatoria* and *Cladophora* (Khanum 1982). The results presented above indicate that *Spirogyra* co-occurs with *Cladophora* in both ponds. In the artificial pond in Poznań, *Sirogonium* occurred in the community with *Zygnema* like in a perennial lake (Khanum 1982). Up to eight taxa co-occurred with *Oedogonium* filaments in a mat observed in Konojad pond. This phenomenon confirms the fact that *Oedogonium* mostly forms multialgal mats consisting of several species and might be associated with *Spirogyra* and *Rhizoclonium* (Khanum 1982).

Seasonal pattern of metaphyton

Only a few studies focused on the spatial patterns of metaphyton (Wu & Mitsch 1998). First, the authors observed a small mat of *Hydrodictyon* in a wetland, the cover of which increased during one month to 70% of the total water surface (up to 86%), followed by a decrease to 61%. However, metaphyton later recovered with a new dominant taxon – *Rhizoclonium*, which persisted for a month. The presented study shows that the researched ponds are characterized by a more dynamic taxa replacement. *Ulothrix, Tribonema* and *Mougeotia, Spirogyra* occurred first. Then, filaments of *Cladophora* and *Oedogonium* appeared and dominated from May to September.

Variability in the composition of metaphyton results in many changes and usually does not repeat from year to year (Kelehr & Rader 2008). In Konojad pond, in August and September 2012, the dominance of *Lyngbya hieronymusii* and *Oedogonium capillare* over *Cladophora globulina* was observed (Pikosz 2012). At the same time in 2013, metaphyton in the studied field pond consisted of *Cladophora* spp. and *Oedogonium* spp. in equal proportions. The *Oedogonium* species may grow throughout the year, but the maximum reproductive development in the lowlands was observed in June and, to a smaller extent, in August (Mrozińska-Weeb 1976).

Conclusions

A seasonal survey of macroalgal abundance and species composition of metaphyton in two different ponds were carried out.

Metaphyton in two small ponds in the Wielkopolska region contain taxa from the following genera: *Lyngbya, Spirulina, Ulothrix, Tribonema, Cylindrocapsa, Spirogyra, Sirogonium, Mougeotia, Zygnema, Oedogonium, Chaetophora* and *Cladophora*.

The dominant macroalgal population consists mainly of filamentous genera of *Cladophora, Oedogonium, Spirogyra* and *Zygnema*.

Floating mats of metaphyton show three phases of the spatial pattern among algal populations: (i) the phase of a small abundance of metaphyton, dominated by *Tribonema* and *Ulothrix* species in April. Next, (ii) in May, these species disappeared and were replaced by *Oedogonium* spp. which formed intense blooms in the field pond and by *Spirogyra* spp. in the artificial pond. But from August (iii), monoalgal mats occurred mainly, covering a large area of the water surface.

The results also demonstrated that more data are required on filamentous green macroalgal species growing in small water bodies to more accurately assess their role and seasonal dynamics in the development of littoral communities.

Acknowledgments

This work was partly supported by a grant from the National Centre for Research and Development in Poland (No. PBS/1/A1/2/2012 – Innovative technology of seaweed extracts – components of fertilizers, feed and cosmetics).

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