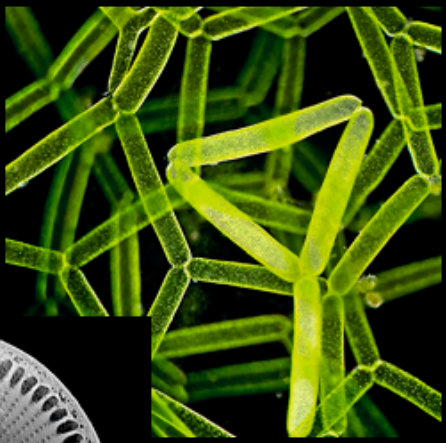
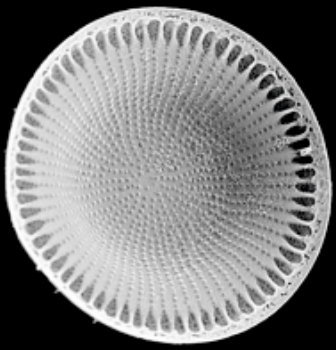
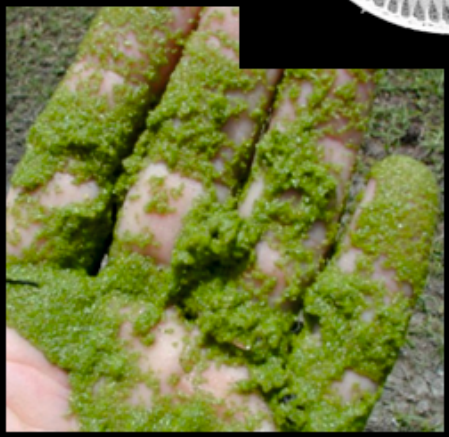
XXXVth International Conference of the Polish Phycological Society

Algae in anthropogenically transformed ecosystems







Book of abstracts

01-04. June 2016
Łódź-Stryków, Poland

XXXVth International Conference of the Polish Phycological Society

Algae in anthropogenically transformed ecosystems

Book of Abstracts

01.-04. June 2016
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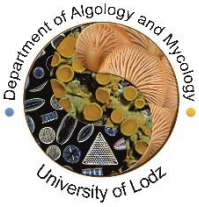
WYDAWNICTWO
UNIWERSYTETU
ŁÓDZKIEGO

ŁÓDŹ 2016

University of Łódź
Faculty of Biology and Environmental Protection
Department of Algology and Mycology

and Polish Phycological Society

Algae in anthropogenically transformed ecosystems



XXXVth International Conference of the Polish Phycological Society

Łódź-Stryków, Poland

01-04 June 2016

The 35th International Conference
of the Polish Phycological Society is dedicated to
prof. Barbara Rakowska and prof. Horst Lange-Bertalot

University of Łódź
Faculty of Biology and Environmental Protection
Department of Algology and Mycology

and Polish Phycological Society

Algae in anthropogenically transformed ecosystems

Book of Abstracts
35th International Conference
of the Polish Phycological Society
Łódź-Stryków, Poland
01-04 June 2016

WYDAWNICTWO
UNIWERSYTETU
ŁÓDZKIEGO

Edited by
Paulina Nowicka-Krawczyk
and Joanna Żelazna-Wieczorek

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Grażyna Samek

PROGRAMME

01st June 2016

(Faculty of Biology and Environmental Protection, University of Łódź, Łódź
Building "D" at Pomorska 141/142 str. – entrance at Matejki str.)

08.30-10.00 Registration

10.00-10.30 Opening Ceremony

10.30-13.00 PLENARY SESSION

10.30-11.00 VARIOUS ASPECTS OF ANTHROPOGENIC IMPACT ON ALGAL FLORA
Pawlik-Skowrońska Barbara

11.00-11.30 LONG-TERM STUDIES ON SPRING-HABITAT ALGAE AND CYANOBACTERIA IN THE ALPS UNDER THE INFLUENCE OF ENVIRONMENTAL CHANGE
Cantonati Marco

11.30-12.00 FRESHWATER DIATOMS IN THE MARITIME ANTARCTIC REGION : BIODIVERSITY HOTSPOT OR TAXONOMIC ARTEFACT?
Van de Vijver Bart

12.00-12.30 THE IMPORTANCE OF THE EPITYPE CONCEPT FOR RELIABLE SPECIES DETERMINATION IN PROTISTS SUCH AS DINOPHYTES
Gottschling Marc, Kretschmann Juliane, Elbrächter Malte

12.30-13.00 SCIENTIFIC PATHWAY OF PROFESSOR BARBARA RAKOWSKA: A CONTRIBUTION TO THE PROGRESS OF POLISH PHYCOLOGY
Szczepocka Ewelina et al., Paczuska Bogna

13.00-13.45 Lunch

13.45-14.45 Sponsors presentations

13.45-14.05 LASER SCANNING CONFOCAL MICROSCOPY – LOOKING FORWARD TO YOUR DISCOVERY
KAWA.SKA (Korczyński Jarosław)

14.05-14.25 SEM AND AFM MICROSCOPY IN BIOLOGICAL SAMPLES RESEARCH
PIK INSTRUMENTS (Lamczyk Marcin, Jedyński Marcin)

14.25-14.45 IMAGING OVER DIFFRACTION LIMIT – SUPER-RESOLUTION MICROSCOPY
PRECOPTIC (Wojciechowski Michał, Ziółkowski Tomasz)

15.00-18.00 Guided tour through the Struga Dobieszkowska Nature Reserve

15.00-18.00 Microscopic Imaging Techniques Workshops
(detailed part for registered participants)

18.15-19.30 Bus transfer to Stryków,
Registration at the Hotel 500

19.30-20.30 Supper

02nd June 2016

(Hotel 500, Stryków, Warszawska 1 str.)

08.00-09.00 Breakfast

09.15-11.00 SESSION 1

Chair: Perti Eloranta

09.15-09.35 EUGLENOPHYTES FROM EL-FARAFRA OASIS (WESTERN DESERT, EGYPT)
Wołowski K., Saber A., Cantonati M.

09.35-09.55 TAXONOMIC CLARIFICATION OF THE UNUSUAL DINOPHYTE GYMNODINIUM LIMNETICUM WOŁOSZ. (GYMNODINIACEAE) FROM THE TATRA MOUNTAINS
Kretschmann J., Filipowicz N., Owsianny P., Zinßmeister C., Gottschling M.

09.55-10.15 PRINCIPLES OF THE MODERN POLYPHASIC CLASSIFICATION OF CYANOBACTERIA
Komárek J.

10.15-10.35 CHANGES IN THE CLASSIFICATION OF CYANOBACTERIA OCCURRING IN THE GULF OF GDAŃSK AND OTHER PARTS OF THE SOUTHERN BALTIC SEA
Pliński M., Surosz W.

10.35-10.55 PHOTOTROPHIC MICROORGANISMS OF TRAVERTINE FIELDS IN MOČIAR (C SLOVAKIA)
Hindáková A., Hindák F.

10.55-11.15 DYNAMICS IN CYANOBACTERIAL COMMUNITIES IN RELATIVELY STABLE ENVIRONMENT (AMBIENT SPRINGS ON QUATERNARY FORMATIONS)
Nowicka-Krawczyk P., Knysak P.

11.10-11.30 Coffee break

11.30-13.30 SESSION 2

Chair: Konrad Wołowski

11.30-11.50 ACTIVITY OF METABOLITES PRODUCED BY *NOSTOC* CF. *EDAPHICUM*
Kerlin Adriana

11.50-12.10 TRICHOME FORMATION FROM A SINGLE TERMINAL CELLS IN CYANOBACTERIUM *APHANIZOMENON GRACILE*
Wejnerowski Ł, Wojciechowicz K.M., Glama M

12.10-12.30 ECOLOGICAL PLASTICITY OF LYCHNOTHAMNUS BARBATUS: IMPLICATIONS FOR BIOMONITORING OF CONTEMPORARY AQUATIC ENVIRONMENTS AND PALAEOENVIRONMENTAL RECONSTRUCTIONS
Pełechaty M., Brzozowski M.

12.30-12.50 HOW TO ACCURATELY ESTIMATE THE BIOVOLUME OF PHYTOPLANKTON?
Napiórkowska-Krzebietke A., Kobos J

12.50-13.10 PHYCOREMEDIATION OF WASTEWATER AS A TOOL TO REDUCE NUTRIENTS IN AQUATIC ECOSYSTEMS
Koreivienė J., Staniulis D., Želvis K., Karosienė J.

13.10-13.30 POLISH PARTICIPATION IN THE EUROPEAN MULTI-LAKE SURVEY (SUMMER 2015) – PRELIMINARY RESEARCH
Kobos J., Toporowska M., Napiórkowska-Krzebietke A. et al.

13.30-14.30 Lunch

14.45-20.00 Guided tour
UNIEJÓW, CITY OF THE FUTURE, - IMPLEMENTATION THE SUSTAINABLE, ECOLOGICAL DEVELOPMENT PLAN

20.30 Bonefire

03rd June 2016

(Hotel 500, Stryków, Warszawska 1 str.)

08.00-09.00 Breakfast

09.15-13.00 SESSION 3

Dedicated to prof. Horst Lange-Bertalot

Horst Lange-Bertalot and Manfred Ruppel
an example of long-term coexistence of excellence
in diatomology and electron microscopy

Chair: Marco Cantonati, Andrzej Witkowski

09.15-09.30 HORST LANGE-BERTALOT PROFESSOR AND MASTER
Witkowski A., Żelazna-Wieczorek J.

09.30-09.50 SOME RARE AND NEW RECORDS FROM KÜTAHYA RUNNING WATERS
Solak C. N., Kulikovskiy M., Kaleli A., Yilmaz E.

09.50-10.10 NEW GENERA AND SPECIES OF FRESHWATER DIATOMS REPORTED FROM OLIGOTROPHIC KARST REGIONS IN GUIZHOU PROVINCE, CHINA
Kociolek J.P., You Q., Lowe R.L., Stepanek J., Wang Q.

10.10-10.30 THE DIATOM GENUS PSAMMOTHIDIUM IN SOUTHERN POLAND
Wojtal A.Z.

10.30-10.50 A PRELIMINARY STUDY OF BENTHIC DIATOMS IN KNYSZYŃSKA FOREST SPRINGS
Grabowska M., Danilczyk M., Jekatierynczuk-Rudczyk E., Fieducik J., Jankowska L.

10.50-11.20 Coffee break

11.20-11.40 USE OF MOLECULAR MARKERS IN DOCUMENTING THE BIODIVERSITY OF DIATOM (BACILLARIOPHYCEAE) ASSEMBLAGES FROM THE LITTORAL ZONE OF THE YELLOW SEA, NE CHINA AND W KOREA
Witkowski A. Li C., Zgłobicka I., Yu S., Ashworth M., Qin S., Krzywda M., Ruppel M., Park J., Wang Y.

11.40-12.00 BIOPROSPECTING FOR OIL IN POLAND WITH DIATOMS
Kociolek J. P., Witkowski A.

12.00-12.20 EXPERIMENTAL APPROACH TO DETERMINE A TEMPERATURE TOLERANCE FOR THE SELECTED MARINE BENTHIC DIATOMS (BACILLARIOPHYTA) FROM THE SOUTH AFRICA
Dąbek P., Witkowski A., Górecka E., Krzywda M., Bornman T.G.

12.20-12.40 CRITICAL EVALUATION OF AN INTERCALIBRATION EXERCISE IN DIATOM BASED MONITORING IN POLAND
Zgrundo A., Majewska R., Kelly M.

13.00-14.00 Lunch

14.00-16.00 SESSION 4

Dedicated to prof. Horst Lange-Bertalot

Chair: Bart Van de Vijver

14.00-14.20 DISTRIBUTION, MORPHOLOGICAL VARIATION AND PHYLOGENY OF DIATOM (BACILLARIOPHYCEAE) GENUS OPEPHORA BASED ON RESEARCH OF THE CLONAL CULTURES
Li C., Witkowski A., Dąbek P., Ashworth M., Sato S., Górecka E., Krzywda M.

14.20-14.40 DIATOMS (BACILLARIOPHYTA) OF THE BUNKER VALENTIN IN BREMEN-FARGE, GERMANY
Bąk M., Kaniak A.

14.40-15.00 CENTRIC DIATOMS IN AN IRON ORE POST-MINING RESERVOIRS
Olszyński R.M.

15.00-15.20 COMPARATIVE ACCOUNT OF DIATOM ASSEMBLAGES IN SEDIMENT CORES: AN INTER- AND INTRA- CORE ANALYSIS FROM INDIAN SUNDARBANS
Mandal M., Biswas B., Sarkar N. S.

15.30-16.30 Poster session with coffee break

17.00-18.30 Meeting of the Polish Phycological Society

20.00 Banquet

04th June 2016

(Hotel 500, Stryków, Warszawska 1 str.)

08.00-09.00 Breakfast

09.15-10.00 Summary Meeting

10.15-10.45 Coffee Break

11.00 Bus transfer to Łódź

MICROSCOPIC IMAGING TECHNIQUES WORKSHOPS

DETAILED PART (for registered participants)
1st of June 2016, Wednesday, Łódź

- Participants will be divided into 3 groups (6 per group);
- Each hour will be devoted to practice with different microscopic techniques
  – confocal microscopy (chair: KAWA.SKA);
  – SEM microscopy (chair: PIK-INSTRUMENTS);
  – super high resolution light microscopy (chair: PRECOPTIC Co.);
- Participants are welcome to bring their own samples (wet samples) or send us the material via post-office or messenger to pre-preparation for SEM (in this case contact us via mail: fyko2016@biol.uni.lodz.pl for further assistance)

During the Conference at the Hotel 500
each participant may take a part in
MICROSCOPIC IMAGING TECHNIQUES WORKSHOPS
and work with advanced microscopes under the supervision
of sponsors` specialists

OPEN PART (for all participants)
2nd-3rd of June 2016, Thursday-Friday, Stryków

- During 2nd and 3rd of June 2016 in Stryków all participants will have an opportunity to work with advanced microscopes under the supervision of sonsors` sepcialists;
- All participants may take a valuable microphotographs for their publications with use of confocal and super high resolution light microscopes;
- Participants should bring their own samples

FOREWORD

Dear colleagues,

We are honored to welcome you to the XXXVth International Conference of the Polish Phycological Society, which is organized by the Department of Algology and Mycology, Faculty of Biology and Environmental Protection, University of Łodz and the Polish Phycological Society. Our meeting will be held from 1st till 4th of June 2016 in Łódź and Stryków, Central Poland, and it is devoted to *Algae in anthropogenically transformed ecosystems.*

In times of expanding urbanization and industrialization, many aquatic ecosystems of the world have been variously transformed. It raises the question about communities of algae, how did they react to anthropogenic impact. Our meeting presentations cover aspects of short- and long-term human influence on aquatic ecosystems in the world. Presentations encompass issues of maintaining biodiversity of algae and environmental capacity of aquatic ecosystems in relation to plasticity and resistance of species to human pressure.

We have a great pleasure to dedicate this meeting to Professor Barbara Rakowska and Professor Horst Lange-Bertalot due to their anniversaries.

Finally, we would like to thank the presenters for their willingness to share their latest research and ideas.

Joanna Żelazna-Wieczorek
Head of the Department of Algology and Mycology UŁ
and the Phycological Team from Łódź

PLENARY LECTURES

VARIOUS ASPECTS OF ANTHROPOGENIC IMPACT ON ALGAL FLORA

Pawlik-Skowrońska Barbara

Dept. of Hydrobiology, Univ. of Life Sciences in Lublin, Poland
barbara.pawlik@up.lublin.pl

Algae, a complex ecological group of primary producers, are subjected to environmental changes caused by different human activities. The most dangerous activities for algae are those leading to direct water and soil pollution by toxic metals (e.g. metal mining and processing) and biogenic compounds (from agriculture, waste waters, etc.). Morphological disturbances in algal habitats (e.g. construction of tailing ponds, dam reservoirs, lake modifications and water management) affect local algal communities as well. Various consequences of the anthropogenic impact are complex and can comprise a decrease in algal species richness, changes in their biodiversity but also evolution of ecotypes resistant to specific pollutants or mass development of undesirable or toxigenic species (e.g. Cyanoprokaryota). Final effects of such phenomena can be hazardous for aquatic biocenoses. Assemblages of algae – both prokaryotic and eukaryotic that react quickly to changes in their habitats are useful indicators of environmental degradation.

Keywords: algae, anthropogenic impact, indicators of degradation

LONG-TERM STUDIES ON SPRING-HABITAT ALGAE AND CYANOBACTERIA IN THE ALPS UNDER THE INFLUENCE OF ENVIRONMENTAL CHANGE

Cantonati Marco

Limnology and Phycology Section, Museo delle Scienze – MUSE, Trento, Italy
marco.cantonati@muse.it

Spring ecotones have traditionally been considered to be high-stability environments, i.e. characterized by small fluctuations of the physical and chemical parameters. Research carried out in the last decades has however highlighted that springs are an extremely heterogeneous habitat category, with different types subjected to contrasting environmental conditions, and including a range of stability degrees from temporary to perennial. Nevertheless springs were also shown to host very relevant proportions of freshwater biodiversity. Moreover, they should be seen as part of the aquifer-spring-stream/wetland/lake system, i.e. as ecotones connecting groundwater and surface waters. This last characteristic allows many springs to integrate in space and time the effects of environmental change. Springs are numerous and widespread (although with a precise geographical distribution) but are also menaced by many impacts, the most important being the exploitation of the high-quality water they discharge (there are striking examples from the Alps documenting the catastrophic drop in numbers of near-natural springs in the last century because of spring capturing). A long-term ecological research study on springs in the south-eastern Alps has been conducted with standardized methods since 1998 but can rely on first data collected in 1993. Results from this study and from other extensive research on springs of the Alps will be used to discuss the effects of environmental change at different scales, from very local (e.g., alterations of spring morphology due to capturing or to natural events) to global (warming, diffuse airborne pollution). More specific topics that will be addressed will be: algal blooms in springs; effects of environmental change on Limestone Precipitating Springs (petrifying springs are the only widespread spring type cited in the EU Habitat Directive), in particular on the characteristic desmid *Oocardium stratum*; possibility to reconstruct long-term change in some spring types with paleolimnological approaches.

Keywords: algae and cyanobacteria, climate change, ecological research, long-term water overdraft, paleolimnology, spring habitats

FRESHWATER DIATOMS IN THE MARITIME ANTARCTIC REGION : BIODIVERSITY HOTSPOT OR TAXONOMIC ARTEFACT?

Van de Vijver Bart

Dept. of Bryophyta & Thallophyta, Botanic Garden Meise, Belgium
ECOBE, Dept. of Biology, Faculty of Science, Univ. of Antwerp, Wilrijk, Belgium
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The maritime Antarctic region includes the Antarctic Peninsula and several islands and archipelagos in the South Atlantic Ocean. Although the variation in freshwater habitats is rather limited, the region has sufficient opportunities for the non-marine diatom microflora to develop. Due to force-fitting of most taxa in North American or European names and taxonomic drift, the non-marine diatom flora observed in this region was considered for a long time almost entirely composed of essentially cosmopolitan taxa such as *Luticola mutica*, *Navicula veneta*, *Pinnularia microstauron* or *Amphora veneta*.

The past few years, a thorough revision of the diatom flora started which resulted in a completely different appreciation of the present diatom diversity. A highly specific diatom flora seems to be present in the Maritime Antarctic Region with a large degree of regional endemism that was observed on most of the investigated locations such as the South Shetland Islands and James Ross Island. In most genera, more than 50% of the observed taxa could not be identified using the present-day taxonomic literature and were described as new for science. Typical examples of this revision include the large diversity in the genera *Pinnularia*, *Diadesmis*, *Luticola* and *Muelleria*. Several taxa, such as *Neidium nyvltii*, show a striking resemblance with taxa in the Arctic Region and even present similar ecological conditions. Whether these taxa have vicariate distributions or represent different taxa occupying similar ecological niches feeds the ongoing debate on the biogeographical distribution of the (Antarctic) diatom flora.

The present observations increase the generally accepted diversity of this Region. Since most of the taxonomic changes rely on the application of a narrower species concept involving a more critical analysis of the morphological features, it is highly likely that this high diversity is just the result of a taxonomical artefact. Although in other taxonomic groups such as Nematodes, a biodiversity hotspot could be observed in this region, it still remains unclear whether a similar pattern defines the diatom diversity.

The results are important in the light of current climatic changes that strike the Antarctic Region perhaps more than any other region in the world. Knowing its actual biodiversity, even of the smallest organisms forming the Antarctic ecosystems is over crucial importance. It will allow to detect future changes and its effect on the ecosystems.

Keywords: Antarctica, biogeography, diatoms, taxonomy

THE IMPORTANCE OF THE EPITYPE CONCEPT FOR RELIABLE SPECIES DETERMINATION IN PROTISTS SUCH AS DINOPHYTES

Gottschling Marc[1*], Kretschmann Juliane[1], Elbrächter Malte[2]

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[2]Wattenmeerstation Sylt des Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, List/Sylt, Germany
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For unicellular organisms such as dinophytes, the biodiversity assessment started in the late 18th and early 19th century using light microscopy. Type material, particularly of older descriptions, consists of specimens permanently mounted on glass slides (a historically important example is the Ehrenberg Collection curated at the Museum for Natural History in Berlin) or of illustrations only. In many cases, type material is ambiguous and makes reliable species determination problematic or impossible because of various sources of error (including imperfect documentation of subcellular diagnostic traits or insufficient morphological differentiation within cryptic species complexes). To clarify the taxonomic identity of such ambiguous scientific names and for a correct application, the International Code of Nomenclature for algae, fungi and plants (ICN) provides the tool of designating an epitype. Epitypification has great potential for a stable taxonomy in the various unicellular organismal groups, but relatively few such studies have employed this approach in the past. In our ongoing research, we clarify the taxonomic identity of dinophyte species (some of them important and widely distributed such as *Scrippsiella acuminata* and *S. erinaceus*: Thoracosphaeraceae, Peridiniales) by collecting material at type localities. After establishing of living strains, the species are DNA-barcoded using rRNA sequences and investigated using modern light and scanning electron microscopy. Strains being morphologically consistent with corresponding protologues are used for designation of interpretative epitypes in form of permanent slides for light microscopy. The significant difference to the historical types is that epitypes are linked to living material enabling the generation of DNA sequences as well as experiments in ecology and physiology. Thus, epitypification is a key tool for reliable species determination ensuring unambiguous links between a scientific species name, its protologue, morphology, ultrastructure, genetic characterisation and spatial distribution, all of which have importance especially for character-poor, unicellular organisms such as dinophytes.

Keywords: determination, history, International Code of Nomenclature, taxonomy

SCIENTIFIC PATHWAY OF PROFESSOR BARBARA RAKOWSKA: A CONTRIBUTION TO THE PROGRESS OF POLISH PHYCOLOGY

Szczepocka Ewelina[1*], Żelazna-Wieczorek Joanna[1], Nowicka-Krawczyk Paulina[1], Knysak Piotr[1], Olszyński Rafał[1], Paczuska Bogna[2]

[1]Dept. of Algology and Mycology, Faculty of Biology and Environmental Protection, Univ. of Łódź, Poland
[2]Dept. of Botany and Ecology, Univ. of Science and Technology, Bydgoszcz, Poland
[*]evelina@biol.uni.lodz.pl

Professor Barbara Rakowska has started up her scientific pathway at the University of Łódź. She graduated from the Faculty of Biology and Earth Sciences UŁ, with a M.Sc. thesis *"Observations of Vaucheria dichotoma (L.) Agardh in Pełczyska II spring "*. She prepared the thesis under the supervision of prof. Joanna Z. Kadłubowska at the Algology Laboratory of the Department of Plant Systematics and Geography UŁ. During the PhD studies, Professor B. Rakowska expanded her scientific interests of new groups of algae and their response to anthropogenic impact. She was promoted to doctoral degree with a dissertation *"Algae present in Bzura River including the impact of wastewaters on their qualitative and quantitative composition"*, prepared under the supervision of prof. Joanna Z. Kadłubowska. As a result of extensive research in the field of biology and ecology of diatoms, prof. B. Rakowska obtained a Habilitation. Her post-doctoral monograph *"Diatom diversity studies of aquatic ecosystems in the Polish Lowland"* begins numerous publications, which contribute to diatoms, their bioindication value, and their role as a biomarkers of anthropogenic transformations.

Prof. B. Rakowska scientific interests are focused on rivers of various ecological state and sizes, springs, lakes, reservoirs both natural and artificial including post-mining one, and peat bogs in Central Poland. One of the main issue of prof. B. Rakowska research was to determine the influence of physicochemical and anthropogenic factors on the assemblages of diatoms, and to define the tolerance range of individual taxa to hydrochemical parameters. Professor has developed a list of diatoms, which are sensitive, tolerant and resistant to organic pollution, including taxa characteristic for aquatic ecosystems of different ecological status. Professor B. Rakowska had chosen the Bzura River, for the majority of her studies. The river became a model ecosystem reflecting ecological changes caused by municipal and industrial wastewaters. Her observations revealed how algae in phytobenthos respond to heavy anthropogenic pollution.

Professor Barbara Rakowska was a promoter of three PhD dissertations on diatoms and their use in the bioindication. She has transmitted her scientific passion to

many students and young scientists, who become engage in the aspects of water quality assessment and protection of aquatic ecosystems. Thanks to her support, two previous Phycological Meetings were organized: the XIth International Conference in 1992, Łódź-Bronisławów; and the XXVIIth International Conference, in 2008, Łódź-Spała.

Keywords: diatoms, indicator value, polish phycology

SPONSOR

LASER SCANNING CONFOCAL MICROSCOPY – LOOKING FORWARD TO YOUR DISCOVERY

Korczyński Jarosław

Kawa.ska Company; ul. Zaczarowanej Róży 1; 05-540 Zalesie Górne, Poland
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Laser Scanning Confocal Microscope (LSCM) is an invaluable tool for a wide range of research in the field of biological and medical sciences. Confocal microscope, using pinhole diaphragm, allows to create a thin, optical cross-sections of live or fixed specimens. Modern confocal systems use lasers – point light sources – to excite fluorescent dyes present in the specimen, and point detectors for analysis of the emitted fluorescence. This characteristic allows for a more precise visualization of the examined samples with higher resolution and contrast, as well as creation of three-dimensional (3D) image reconstruction.

In this field, Leica confocal microscopes offer a range of innovative solutions that facilitate i.e. experiments with plant material, and allow to visualize the samples with super-resolution, high sensitivity and high speed acquisition. These confocal systems, thanks to White Light Laser and spectral detectors, give the user the spectral freedom – allows to choose freely any excitation and emission wavelength in visible range with the accuracy of 1 nm. In addition, Leica microscope can be a filter-free system - which not only provides a great flexibility in selection of the light parameters, but also it can increase the intensity of the detected fluorescence.

Moreover modern confocal microscopes allow to visualize the probes with the resolution up to 50 nm (for example STED technique), together with the speed acquisition of up to 40 frames per second (systems with resonance scanner). With all these facilities LSCM are gaining a tremendous popularity in the environment of researchers from various fields.

Keywords: confocal microscope, White Light Laser, spectral detection, super resolution

SPONSOR

SEM AND AFM MICROSCOPY IN BIOLOGICAL SAMPLES RESEARCH

Lamczyk Marcin, Jedyński Marcin

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PIK-Instruments company is presented. PIK-Instruments is a distributor of high-end scientific instruments and represents, among others, Phenom-World and Nanosurf producers of cutting-edge desktop scanning electron microscopes (SEM) and atomic force microscopes (AFM), respectively. There are many different models of SEM and AFM microscopes fitting into broad range of life science applications. Furthermore, world's first fully integrated SEM and fluorescence microscope for correlative light and electron microscopy technique (CLEM) is presented. This is fast, precise and convenient all-in-one solution for moving between light and electron in one compact microscope. Examples of application of Phenom-World SEMs and Nanosurf AFMs in the field of life science are presented.

Keywords: AFM, SEM

SPONSOR

IMAGING OVER DIFFRACTION LIMIT – SUPER-RESOLUTION MICROSCOPY

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Super-resolution microscopy is one of the most significant developments in biological imaging since the invention of the microscope. Super-high Resolution Microscopes, with capabilities that seemed impossible just a decade ago, have arrived, greatly extending the boundaries of cellular imaging. Nikon has recently introduced two new systems, based on two highly effective technologies developed by researchers at Harvard and UCSF, respectively.

Keywords: Super-high Resolution Microscopy

LECTURES

SESSION 1 & 2

cyanobacteria, algae and biomonitoring

Thursday, 2nd of June 2016

EUGLENOPHYTES FROM EL-FARAFRA OASIS (WESTERN DESERT, EGYPT)

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Oases include highly isolated freshwater habitats, often characterized by extreme environmental conditions (e.g., high electrolyte content and temperature). These environments can provide peculiar, specific habitats for algae and cyanobacteria, but they are highly impacted (water drawdown, organic pollution) by different human activities, mainly agriculture. The main aim of this study was to assess euglenoid species diversity in El-Farafra Oasis (86,200 km^2; Western Egypt). This natural depression is located in a hyper-arid region. It has a hot desert climate, with mean annual air temperature of ca. 22 °C and average annual precipitation of ca. 2 mm. Groundwater is the only available water source in El-Farafra Oasis, supplied from two main aquifers: the shallow Post-Nubian Aquifer System, and the deep Nubian Sandstone Aquifer System, the world's largest non-renewable groundwater system. Materials were collected mainly during the spring season of 2015 from different freshwater environments: (1) Abu Nuss Lake, fed by agricultural water and also affected by fish farming, (2) agricultural drainage at Lewa Soubah village, and (3) the slow-flowing rheocrenic ambient spring Ain Khadra, also called Ain El-Wadi, in White Desert National Park. Euglenoids were totally absent in other habitats and sites sampled (total = 22). Ain Khadra is a freshwater rheocrenic spring (T.D.S. = 170 mg L^{-1}), while Abu Nuss Lake and the agricultural drainage are inland waters found to have high electrolyte content (T.D.S. = 2090 and 2990 mg L^{-1}, respectively). Our study revealed 20 taxa of euglenoids: *Euglena* (4), *Euglenamorfis* (1), *Euglenaria* (2), *Discoplastis* (1), *Lepocinclis* (4), *Phacus* (5), *Trachelomonas* (1), and one unidentified species. Although all species found are established and widely distributed, one of them (*Peranema inflexum* Skuja, the only colourless species found) proved to be a new record for Egypt. As shown by studies of other algal groups (diatoms), the preponderance of cosmopolitan and common species is typical for polluted inland waters, even those in extreme, isolated, or remote habitats. More in-depth studies are needed, particularly in oases and other remote habitats, to complete our knowledge of euglenoid biodiversity in Egypt.

Keywords: Egypt, Euglenophyta, Farafra Oasis

TAXONOMIC CLARIFICATION OF THE UNUSUAL DINOPHYTE *GYMNODINIUM LIMNETICUM* WOŁOSZ. (GYMNODINIACEAE) FROM THE TATRA MOUNTAINS

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Almost a century ago, Jadwigia Wołoszyńska (1882–1951) described numerous dinophyte species from various freshwater lakes in Poland. However, most of those species have never been re-investigated in detail based on living material from their type localities. The precise taxonomic identity of many Polish dinophyte species, and their names, thus remain unclear at present. One of those names with unclear identity was *Gymnodinium limneticum* Wołosz. from Morskie Oko in the Polish Tatra Mountains. The species was unusual in exhibiting capsoid cells as predominant life-history stage, which were embedded and dividing in extensive mucilage leading to an enkaptic, pseudocolonial system. If any original material was preserved, it has not been located in the course of this study, and figs 1–5, pl. I 1–11 from Wołoszyńska (1935) are therefore the only original elements of *G. limneticum*.

For clarifying the identity of *G. limneticum*, we collected, isolated, and cultivated the species from the type locality for contemporary morphological and molecular investigations. The established strain was morphologically consistent with the corresponding protologue and in order to avoid further confusion with the name *G. limneticum*, we used the strain for the designation of an interpretative epitype in form of permanent slides for light microscopy.

Additionally, we used the newly generated sequences to provide a comprehensive molecular phylogeny of the Gymnodiniaceae s.str., of which *Gymnodinium limneticum* was clearly identified as element. Within the lineage, *G. limneticum* was only distantly related to the type species of *Gymnodinium*, *G. fuscum*.

Rather, it constituted a monophyletic group together with species assigned to *Spiniferodinium* and as a nomenclatural result, we propose a new combination to *Sp. limneticum*. As *Spiniferodinium* now includes dinophyte species inhabiting marine or freshwater environments as well, our investigations may provide additional evidence for an evolutionary scenario with corresponding transitions being more frequent than considered before.

Keywords: dinophyte, dinoflagellate, epitype, morphology, phylogeny, taxonomy

PRINCIPLES OF THE MODERN POLYPHASIC CLASSIFICATION OF CYANOBACTERIA

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Taxonomic classification is the only method for the recognition of organismal diversity. It is difficult in prokaryotic phylogenetically old and continually adaptable cyanobacteria, ecologically important during millions years in the biosphere. They have the bacterial origin, but they developed the whole photosynthetic system, produced large deposits of limestones, and influenced our atmosphere. Therefore cyanobacteria belong to the prokaryotic phototrophic organisms, forming also multicellular thallus with specialized cells. All these characteristics and evolutionary principles influence their taxonomic classification, which was based for a long time on morphology, similarly as in eukaryotic algae. However, this approach must be continually corrected according to the introduction of modern, more precise methods. The data derived from EM methods, results of molecular analyses and ecological data must be used in combination to the corrected evaluation of cyanobacterial diversity. This "polyphasic approach" must be recently used for the taxonomic classification of cyanobacteria. The genetic analysis must be a basal criterion, but it is not valid absolutely and the results must be combined and modified by morphological and ultrastructural markers, and ecological and ecophysiological limits. It was proved that the traditional system, dividing cyanobacteria in three main groups (coccal, trichal and trichal with heterocytes) is not absolutely valid and must be modified. – The main principles of the polyphasic evaluation of cyanobacteria will be discussed and explained in the lecture. The recent state of the cyanobacterial system with all consequences and correlations between mentioned criteria will be demonstrated.

Keywords: cyanobacteria, modern methods, polyphasic approach, taxonomic classification

PHOTOTROPHIC MICROORGANISMS OF TRAVERTINE FIELDS IN MOČIAR (C SLOVAKIA)

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Cyanobacteria and algae are able to colonize also recently forming travertine fields. Some microorganisms attach directly the surface of fields, other penetrate deeper into the limestone substrate, resembling sand psammon. The mass development of microorganisms is demonstrated by brownish, blue-green, pink or black colouration of travertine surface.

Phototrophic microflora of recently forming travertine fields of the fen Močiar near Stankovany (C Slovakia) is presented. These peculiar natural formations are located in submountain region, on a slope medow, about 440 m a.s.l. Mineral water is originated from two active boreholes with characteristics of rheocrene and limnocrene springs, it is sulphate–hydrocarbonate, rich on calcium, with water temperature from 18 to 26 °C and pH 6.1-6.4.

Cyanobacterial mats are formed just in surrounding of boreholes and in shallow stream flowing down the hill. They are composed of green to brown colonies of the genera *Phormidium* (*Ph. tergestinum*, *carboniciphilum*), *Pseudanabaena galeata*, *Leptolygbya* and *Geitlerinema*.

The stream flows into several small shallow cascades, in which the amount of water is decreasing from the first to the last one, while, in contrary, the amount of calcium carbohydrate deposit is increasing. The whole area of this part is owergrown by *Calothrix* cf. *fusca*, together with *Phormidium* spp., *Leptolygbya* and pennate diatoms. The marginal parts of cascades are occupied by coccal cyanobacteria *Gloeocapsa* cf. *biformis, Aphanothece bullosa*, *Chroococcus turgidus*, *Cyanosarcina chroococcoides* and by some colonies of filamentous cyanobacteria *Pseudanabaena galeata*, *Leptolyngbya* spp. and *Nostoc* sp. In these places we found very rare coccal rhodophyte *Chroothece mobilis* which is the first finding in Slovakia and the second in Europe.

Below the cascades, three types of travertine fields can be recognized. The first one is remarcable with relatively highest content of water and by yellow-brown colonies of *Phormidium beggiatoiforme*, visible on the surface of field as irregular brown ribbons. The second type, which is overflooded by water only partly, is occuped mainly by filaments of *Calothrix fusca*. Cyanobacteria *Phormidium Schizothrix*, *Leptolygbya*, together with diatoms *Cymbella*, *Craticula*, *Mastogloia* are subdominant. On some calcium carbonate crystals big solitary coenocytis cells of green alga *Bracteacoccus giganteus* are attached. The last type can be designated as a psammonic community,

composed by *Calothrix* cf. *fusca*, *Leptolygbya*, *Phormidium*, *Schizothrix calcicola*, *S. fasciculata*, *Geitlerinema*. The diatom flora is mainly dominated by representatives of the genera *Encyonopsis* and *Craticula*, as well by *Cymbella lange-bertalotii*, *Crenotia thermalis*. Colouration of these crust is from yellow, brown, pink up to greyish or white

Evidently, cyanobacteria and algae are able to live among the crystals of $CaCo_3$ with minimal amount of capillary rised mineral water. The microflora of studied travertine field is unique and deserves strong protection of the whole area.

This work is supported by the grant agency VEGA, No. 2/0060/15

Keywords: chliaothermal springs, phototrophic microorganisms, C Slovakia, travertine piles

DYNAMICS OF CYANOBACTERIAL COMMUNITIES IN POTENTIALLY STABLE ENVIRONMENT (AMBIENT SPRINGS ON QUATERNARY FORMATIONS)

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Ambient springs are often referred as an example of ecosystem with stable environmental conditions. Examining the environmental parameters of a single crenological site, especially large, non-karstic one, supplied from a deep aquifer, can lead to conclusion that spring is a static biotope. On this assumption, static biotope fosters development of constant communities with a stable qualitative and relatively stable quantitative structure. Moreover, studies carried out on several springs revealed that every single spring is a specific habitat with different, and relatively stable environment.

Two-year study of cyanobacteria in different microhabitats of rheocrene and limnocrene ambient springs located on quaternary geological formations showed that there are a seasonal dynamics and spatial differentiation in cyanobacterial communities. Seasonal dynamic is reflected not only by a change in quantitative structure (the number of species and the species biomass) but also by a change in the species composition. Spatial differentiation results from the variation of microhabitats and spring types.

Cyanobacterial communities in limnocrene springs were at equilibrium state, in contrast to those in rheocrene springs, where in winter vegetative forms were absent. The highest number of cyanobacteria and the lowest dynamics were found in peryphyton on concrete walls of limnocrenic springs and in epixylon in rheocrenic springs. The least biomass of cyanobacteria was recorded in benthos in both spring types.For the purpose of understanding which environmental factor or a group of factors had the highest influence on shaping the cyanobacterial communities, the BIO-ENV procedure was performed. The procedure revealed that the most important was a group of ions not related to the nature of the spring environment – NH_4^+, NO_2^-, NO_3^- and PO_4^{3-}. The presence of these ions in groundwater is a result of human direct and indirect activity in spring catchment area. Environmental conditions in the studied springs were relatively stable, however, they were modified by the human impact and by weather conditions.

Keywords: ambient springs, cyanobacteria, seasonal dynamics, spatial differentiation

ACTIVITY OF METABOLITES PRODUCED BY *NOSTOC* CF. *EDAPHICUM*

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Cyanobacteria (blue-green algae) are producers of many bioactive metabolites. They may have negative effects on other aquatic biota. Some of the metabolites represent unique structure and specific biological activity. Scientists focus on the studies of secondary metabolites with the potential applications in medicine and pharmacy.

The overall aim of the experiments conducted within this study was to determine the relationship between the structure and activity of metabolites produced by *Nostoc* cf. *edaphicum* CCNP 1411 from the waters of the Gulf of Gdansk. For this purpose, the biochemical assays of fractions and compounds isolated from this cyanobacterium were conducted.

Lyophilized material was extracted in 75 % metanol. In the next step, flash chromatography and preparative chromatography were used. Isolated compounds were identified by liquid chromatography coupled with tandem mass spectrometry (LC-MS/MS). The collected fractions and isolated compounds were analyzed by enzymatic tests using such enzymes as: thrombin, elastase, trypsin, chymotrypsin, carboxypeptidase-A and protein phosphatase.

Nostoc CCNP 1411 was shown to produce many peptides classified to cyanopeptolins (CYPs) and nostocyclopeptides. Several of the compounds revealed inhibitory activity mainly against chymotrypsin, thrombin and trypsin. The activity of CYPs against trypsin was determined by the presence of Arg in the structure of the compounds. The strong activity of metabolites produced by *Nostoc* 1411 against key enzymes indicates possible ecological consequences for other aquatic organisms. The results also show that *Nostoc* cf. *edaphicum* CCNP 1411 is a valuable source of metabolites of potential pharmacological application.

Keywords: cyanopeptolins, enzyme, inhibitors, *Nostoc*

TRICHOME FORMATION FROM A SINGLE TERMINAL CELLS IN CYANOBACTERIUM *APHANIZOMENON GRACILE*

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Cyanobacteria developed different modes for propagation. For example, they can reproduce by binary fission, colony fragmentation, hormogones, akinetes etc. In case of the filamentous cyanobacterium *Raphidiopsis mediterranea*, it has been shown that even morphologically distinct terminal cells can divide and form trichomes. This finding has been recognized as a new reproduction mode in *R. mediterranea*. However, the question arises whether this mode of reproduction is only restricted to this species, whether it is widespread in other cyanobacterial types. In this study, we decided to check whether single terminal cells of filamentous cyanobacterium *Aphanizomenon gracile* could divide and form trichomes. The identification of terminal cells in *A. gracile* is quite simple as these cells are terminally located in trichomes, distinctly thinner and rounded at the end in comparison to other vegetative cells.

Cultures of *Aphanizomenon* (strain CCALA8) were grown in 75 mL tissue culture flasks filled with WC medium. Cultures were continuously and gently shaked on an orbital shaker. Microscopic observations of single terminal cells in cultures were carried out daily using inverted microscope. Moreover, we took the samples for transmission electron microscopy (TEM) in order to analyse the ultrastructure of terminal cells and provide some more detailed evidences that solitary terminal cells have possibility to divide.

We will present firm evidences that solitary terminal cells of *A. gracile* can divide and form a trichomes. Moreover, we will explain step by step how this process takes place.

The National Science Centre in Poland supported this study (grant No. UMO-2012/07/N/NZ8/00166).

Keywords: asexual reproduction, CCALA 8, cell differentiation, cell ultrastructure, terminal cells, transmission electron microscopy

ECOLOGICAL PLASTICITY OF *LYCHNOTHAMNUS BARBATUS*: IMPLICATIONS FOR BIOMONITORING OF CONTEMPORARY AQUATIC ENVIRONMENTS AND PALAEOENVIRONMENTAL RECONSTRUCTIONS

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Lychnothamnus barbatus, the only extant representative of the genus *Lychnothamnus*, can be listed among the rarest and most endangered charophyte (Characeae) species world-wide. Palaeoecological studies have shown that *Lychnothamnus* exists in the world since the late Eocene and in the past was represented by many species. Fossil *Lychnothamnus* remains are used in palaeoreconstructions as a biomarker of a very good water status, mesotrophic or even oligotrophic. This results from the fact that a contemporary representative of this genus is given in the literature usually from low trophy waters, mainly mesotrophic, and the number of its sites dropped significantly in the twentieth century, which was linked with water eutrophication. *Lychnothamnus barbatus* occurs in lakes, rivers, astatic water bodies and wetlands. In Poland, where it is subject to strict protection, but at the same time is characterized by the world's largest number of sites, the currently existing localities are usually documented in mesotrophic lakes. However, there are also sites in eutrophic, and even the highly eutrophic lakes. Regardless of the trophic types of waters, it is listed in lakes subject to different forms of human pressure. It may seem surprising that currently listed in the international literature colonization of new and re-colonization of previously recorded localities concerns eutrophic bodies of water, mostly subject to the recreational use. With time, however, the improvement of water transparency followed by increasing coverage of the species is observed in these lakes. In conclusion, *Lychnothamnus barbatus* has a broader ecological plasticity than that usually reported in the literature, and has currently been noted in waters of high transparency regardless of the trophic status. Forming large communities, the species contributes to improving the clarity of water. It is, therefore, an important element, and also an indicator of the functional interdependencies in the ecosystem, defined as its ecological status.

Keywords: Characeae, *Lychnothamnus barbatus*, ecological plasticity, re-colonization

HOW TO ACCURATELY ESTIMATE THE BIOVOLUME OF PHYTOPLANKTON?

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The biovolume of phytoplankton must be assessed accurately in order to identify the ecological status of water bodies in line with the WFD requirements. The latest European biovolume estimation method can ensure easier and quicker phytoplankton analyses compared with the previous methodology. The standards comprise now 17 geometric shapes and equations suitable for estimations of cell/filament/colony biovolume and additionally include taxa-specific 'geometric correction factors' to fit real shapes and 'hidden dimension factors' to achieve data on hardly measureable dimensions. For few species there are now quite new geometrical shape proposed for biovolume calculation. For example, previously for calculate the biovolume of *Ceratium* six or seven different dimensions were required. Recently, the revised geometric shapes with one or two dimensions and less complicated formulas (DIN EN 16695, 2015) have been proposed. The previously used and the new figures and formulas were verified and applied to biovolume calculations of species belong to genera *Ceratium* and *Pediastrum /Pseudopediastrum*. The results were statistically significantly differentiated (higher or smaller values).

Keywords: biovolume, phytoplankton, geometric shapes

PHYCOREMEDIATION OF WASTEWATER AS A TOOL TO REDUCE NUTRIENTS IN AQUATIC ECOSYSTEMS

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Industry, transport and unsustainable agriculture result in the increased quantity of wastewater and release of nutrients into freshwaters. The application of microalgae for remediation may be helpful to mitigate eutrophication and harmful algae blooms worldwide. Therefore, four coccoid green algae species, particularly *Coelastrum microporum*, *Pediastrum boryanum*, *Scenedesmus acutus*, *S. quadricauda*, were tested as an eco-friendly tool to treat nutrients from the sugar factory wastewater. The growth rate, abundance, biomass yield and the efficiency of nutrient elimination from non-diluted and diluted wastewater were assessed for eight strains. The characteristics of local strains isolated from wastewater pond were compared to those for the strains from the hypertrophic Curonian Lagoon. One week experiment showed that non-diluted wastewater (10.5 mg/l IN, 0.102 mg/l IP, 103 N/P ratio) was suitable to grow for all tested species; the average growth rate 0.42 per day was only slightly lower in wastewater compared to the control media (0.50 per day). Growth rate of the lagoon strains was greater than those from the wastewater pond. The highest abundance (0.9 mln. cells/ml) reached *S. acutus*, *S. quadricauda* and *C. microporum*. Based on biomass yield in seven days, *S. acutus* from wastewater pond (0.26 mg/ml) was the most productive among the small coenobia forming species, whereas *C. microporum* strains (0.35–0.55 mg/ml) – among the large species. The strains from wastewater pond were characterized by higher efficiency of IP removal (100% efficiency) compared to the strains from the lagoon (78.4%–96.7%). *P. boryanum* (wastewater pond, 98.8% efficiency) and *S. quadricauda* (the lagoon, 88.2%) threated IN the most effectively. The results revealed that particular strain characteristics rather than their origin define species productivity and nutrient elimination.

Keywords: coccoid green algae, microalgae, nutrients, remediation, wastewater

POLISH PARTICIPATION IN THE EUROPEAN MULTI-LAKE SURVEY (SUMMER 2015) – PRELIMINARY RESEARCH

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Increased nutrient pollution and global warming may further promote harmful algal and cyanobacterial blooms, adding urgency for scientists and lake managers to understand if and how these two drivers will interact. CyanoCOST and NETLAKE, two European COST actions working on lakes and reservoirs have organized a multi-lake survey across different geographical and climatic regions in Europe. Poland was one of

29 European countries which have signed up for the summer sampling (July-August 2015). An important part of a successful multi-lake survey across different countries was to obtain comparable datasets. To approach this, it was essential to establish standardised sampling, sample processing and adjust analyses among lakes resulting in a genuinely integrated dataset. In Poland, as part of research EMLS, 42 people from 16 research centres formed all together 11 teams to collect integrated water samples and to analyse phytoplankton. Samples were collected once during summer from 63 lakes and reservoirs of different trophy and mixing regime. Then samples were handled in accordance with accepted procedures before sent to different research teams across Europe. Within the project, the following parameters are studied: microscoping analysis of phytoplankton, including cyanobacteria (different laboratories in each participating country), flowcytometry (University of Geneva, CH), dissolved and particulate nutrients (University of Wageningen, NL), phytoplankton pigments (University of Amsterdam, NL) and toxin profiles (Demokritos, GR). In Poland, additional samples for picoplankton, cyanobacterial heterocysts and spores, zooplankton and organic carbon analyses were collected. During Conference preliminary results and conclusions will be presented.

Keywords: cyanobacteria, CyanoCOST, EMLS, NETLAKE

CHANGES IN THE CLASSIFICATION OF CYANOBACTERIA OCCURRING IN THE GULF OF GDAŃSK AND OTHER PARTS OF THE SOUTHERN BALTIC SEA

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The last key for the identification of cyanobacteria from the Gulf of Gdańsk has been published in the year 2007 (Pliński & Komárek, 2007). The classification system of cyanobacteria changed since this year in many aspects, especially based on the molecular sequence data and electron microscopy methods. Komárek et al. (2014) gave a new proposal for taxonomic classification of cyanobacteria. According to this conception the taxonomic system of cyanobactrial genera which occur in the southern Baltic should be as follow:

O. Synechococcales:
- F. Synechococcaceae (*Cyanobium, Cyanodiction, Cyanonephron*, *Lemmermanniella, Rhabdoderma, Rhabdogloea, Synechococcus*);
- F. Merismopediaceae (*Aphanocapsa, Merismopedia, Microcrocis, Pannus*, *Synechocystis*);
- F. Coelosphaeriaceae (*Coelomoron, Coelosphaerium, Snowella, Woronichinia*);
- F. Pseudanabaenaceae (*Jaaginema, Limnothrix, Pesudanabaena*);
- F. Leptolyngbyaceae (*Leptolyngbya, Planktolyngbya, Trichocoleus*);
- F. Schizotrichaceae (*Schizothrix*);

O. Spirulinales:
- F. Spirulinaceae (*Glaucospira, Spirulina*)

O. Chroococcales:
- F. Microcystaceae (*Microcystis*);
- F. Aphanothecaceae (*Aphanothece*);
- F. Gomphosphaeriaceae (*Gomphosphaeria*);
- F. Chroococcaceae (*Chroococcus, Gloeocapsa*);

O. Pseudocapsales:
- F. Hyellaceae (*Hyella, Pleurocapsa*)

O. Oscillatoriales:
- F. Coleofasciculaceae (*Geitlerinema*);
- F. Microcoleaceae (*Microcoleus, Planktothrix, Trichodesmium*);
- F. Homoeotrichaceae (*Homoeothrix*);
- F. Oscillatoriaceae (*Blennothrix, Lyngbya, Oscillatoria, Phormidium,*

Plectonema)

O. Nostocales:

F. Rivulariaceae (*Calothrix, Microchaete, Rivularia*);
F. Tolypothrichaceae (*Tolypothrix*);
F. Hapalosiphonaceae (*Mastigocoleus*);
F. Gloeotrichaceae (*Gloeotrichia*);
F. Aphanizomenonaceae (*Anabaenopsis, Aphanizomenon, Cylindrospermopsis, Dolichospermum, Nodularia*);
F. Nostocaceae (*Anabaena, Cylindrospermum, Nostoc, Trichormus*)

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Keywords: cyanobacteria, Gulf of Gdańsk, taxonomy

LECTURES

SESSION 3 & 4

DEDICATED TO
PROF. HORST LANGE-BERTALOT

Horst Lange-Bertalot and Manfred Ruppel
an example of long-term coexistence of excellence in diatomology and electron microscopy

diatoms

Friday, 3rd of June 2016

HORST LANGE-BERTALOT PROFESSOR AND MASTER

Many diatomologists consider Professor Horst Lange-Bertalot, their friend, and perhaps some think he is our master. The appreciation of Horst by this rather small scientific community is expressed in different ways. The most pleasant way is keeping him in our memories with fond thoughts, and to be in touch as most of us are used to do. We expressed it by sending him interesting diatom images usually marked either "cf." or "sp." and expect he will at least suggest the species name. Numerous colleagues appreciate his contribution in diatom research by giving the names to taxa which are derived either from his first name or from his family name. Hence quite a number of established taxa bears names like: *"horstii", "horstiana", "langebertalotii"* or *"lange-bertalotii"*. However, at certain periods usually, each five years, when he celebrates his "round" birthday, appreciation is expressed in a scientific sessions dedicated to our Master. Like this year when during the Polish Phycological Society Meeting organized by the Łódź University, the Department of Algology and Mycology we celebrate the birthday of Professor Horst Lange-Bertalot, professor, Master and a good friend for many of us.

This year we celebrate the 80th birthday of Horst Lange-Bertalot, a diatom taxonomist of worldwide reputation and honorary member of Polish Phycological Society. His impact on a diatom research has been significant, for current and future generations. Results of his research have implications for ecology (from water pollution to climate change), biodiversity and conservation sciences. This impact has been due in large part to the breadth and depth of Prof. Lange-Bertalot's research record in 4 areas: evaluation of water quality with diatoms, floristics with a focus on Europe, biodiversity discovery on a worldwide perspective, and synthetic works that organize and develop these other studies. Indeed, the two latter aspects of his diatom research we admire the most. His knowledge about nature in general is profound. He is a naturalist in an old sense of this word.

For almost 25 years Polish diatomologists as a whole, in Gdańsk, Kraków, Poznań, Łódź, Olsztyn, Toruń, Warszawa, Wrocław, Rzeszów and Szczecin have been enjoying contacts with Professor Lange-Bertalot. In Gdańsk, Kraków, Poznań and Szczecin he has been a frequent and more than welcome guest. Students, PhD students and Postdocs have benefited significantly from his visits and long sessions devoted to diatom identification. Now we use this opportunity to express our gratitude and deep appreciation to our Jubilee and wish him many happy returns on the occasion of his 80th Birthday. Happy Birthday Dear Horst!

Andrzej Witkowski & Joanna Żelazna-Wieczorek

SOME RARE AND NEW RECORDS FROM KÜTAHYA RUNNING WATERS

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Diatoms are a very diverse group of algae and good indicator organisms in aquatic ecosystems and they occur in a wide variety of environments and show a broad range of tolerance along several gradients of abiotic factors.

Although Turkey has great potential of inland water, relatively is known about the flora. However, it is necessary to study the flora of Turkey as part of the biological monitoring requested by the European Water Framework Directive and also the investigation of the freshwater algal flora. Historically, the first freshwater diatom study was done in 1844 by Ehrenberg based on material collected from Murat and Aras Rivers. Situated between large continents (Eurasia and Africa), Turkey comprises areas of very diverse geological, climatic and environmental conditions, so we should expect that the organisms including diatoms will show high diversity in this region.

The aim of study is to present new sites of rare and new records in Kütahya running waters. For this purpose, the samples (85 points) were collected in May-2009 from three different river catchments (Gediz, Sakarya & Susurluk river catchments) in Kütahya. As a result, totally 73 species (23 were rare and 53 were new record) were given in this study.

This study was partly supported by TUBITAK-114Z006.

Keywords: diatom, Kütahya, new records, running waters, Turkey

NEW GENERA AND SPECIES OF FRESHWATER DIATOMS REPORTED FROM OLIGOTROPHIC KARST REGIONS IN GUIZHOU PROVINCE, CHINA

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A recent (Fall, 2015) collecting expedition to two nature reserves in Guizhou Province, south-central China, resulted in just over 100 collections from a wide range of habitats, including lakes, rivers and a variety of aerophilous habitats, including wet walls, bryophytes and the entrances to caves. This region of China is well-known for the amazing karst features of the topography, and the torquoise-blue water, similar to karst regions in other parts of the world including several parts of Europe. Our preliminary observations suggest that over 70 new species, including 1 new genus, as well as 6 genera not previously-reported from China are contained in the samples. We present light and scanning electron microscope observations to document some of the new taxa, and discuss the need for biodiversity discovery of diatoms in China.

Keywords: biodiversity, China, karst, new genera, new species

THE DIATOM GENUS *PSAMMOTHIDIUM* IN SOUTHERN POLAND

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The genus *Psammothidium* was established by Bukhtiyarova and Round in 1996. They selected *P. marginulatum* (Grunow) Bukhtiyarova & Round as the type species. This genus belongs to order Achnanthales and family Achnanthaceae. The members have linear, elliptic or lanceolate valves, uniseriate striae and terminal raphe fissures are usually deflected to opposite site or are absent. Identification difficulties related to small size, fine ornamentation, and a large morphological variability of the complex are reflected in their intricate nomenclature and taxonomy.

Psammothidium taxa are common diatoms, living attached to various kinds of substrata, so usually to sand grains. They are one of the constituents of periphytic diatom assemblages in freshwater systems. *Psammothidium* is regarded as a frequent component of benthic communities worldwide, and is reported from very diverse aquatic environments. This genus is one of the common and widespread diatom groups inhabiting springs, streams, rivers and lakes in southern Poland. Due to global change affecting oligotrophic waters worldwide, they are seen as threatened environments deserving specific scientific interest. Results of morphological analyses performed with light and scanning electron microscopy on this genus in southern Poland revealed that the genus is represented by taxa such as *P. acidoclinatum, P. altaicum, P. bioretii, P. grischunum, P. helveticum, P. lauenburgianum, P. marginulatum, P. montanum, P. rechtense, P. rostratum* and *P. subatomoides*. Some species are known from oligotrophic waters (e.g. *P. helveticum*, *P. subatomoides*) whereas other are reported from more rich in nutrients waters (e.g. *P. lauenburgianum*). Their distribution in springs, rivers and lakes of southern Poland corresponds well with literature reports of the autecology of *Psammothidium* members. Many of these species are only known from restricted geographical areas, whereas others, are widely distributed, but have defined environmental requirements and are excellent bioindicators. The aim of this presentation was to provide the basic information on morphology and ecology of eleven *Psammothidium* taxa identified from Poland.

Keywords: Achnanthales, Bacillariophyta, ecology, morphology

A PRELIMINARY STUDY OF BENTHIC DIATOMS IN KNYSZYŃSKA FOREST SPRINGS

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Most of the data on diatoms in springs come from mountain and upland areas. The aim of the research was to recognize composition of diatom communities in lowland spring of Knyszyńska Forest (NE Poland). Springs are one of the most precious natural values of the Knyszyńska Forest. So far research of springs has focused on water chemistry. In August in 2014 and 2015 the preliminary study of benthic diatoms was carried out in 27 springs with various types of niches and catchment area. Material for diatom analysis was collected from the surface of stones.

The results showed that springs differed in diatom communities. The highest number of species belonged to genera *Navicula*, *Gomphonema* and *Placoneis*. Among 54 identified diatoms, 3 taxa *Diatoma vulgaris*, *Cocconeis placentula* and *Amphora ovalis*, were the most frequent. Most of the taxa (34) were recorded only once. The highest species richness (15) was recorded in Budzisk and Kołoczne springs. Our research documented that high diversity of catchment area and water quality in springs create high richness of their diatom communities.

Keywords: diatoms, springs, water quality

USE OF MOLECULAR MARKERS IN DOCUMENTING THE BIODIVERSITY OF DIATOM (BACILLARIOPHYCEAE) ASSEMBLAGES FROM THE LITTORAL ZONE OF THE YELLOW SEA, NE CHINA AND W KOREA

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Presented are the results of diatomological studies in the Yellow Sea (NE China, W Korea). The study of the diatom assemblages is based on cultures established from the diatom samples, which have been collected in different seasons from marine littoral and supralittoral zone. Altogether over 200 strains of diatoms have been grown successfully. Their identification was based on light and electron microscopy (LM and SEM) and multigene (nuclear-encoded small subunit ribosomal RNA (SSU) and chloroplast-encoded *rbc*L and *psb*C) phylogeny. Usage of multi-gene phylogenetic approach shows that we are dealing with some groups of clones which represent following genera: *Amphora*, *Navicula* and *Nitzschia*, isolated from different sampling sites. As single entities represented are the following genera: *Amphora* (*Oxyamphora*), *Caloneis*, *Entomoneis*, *Diploneis*, *Halamphora*, *Parlibellus*, *Plagiotropis*, *Pleurosigma*, *Surirella* and *Tryblionella*. Some of the taxa have not been assigned to any established genera and they represent new genera. Included in this group have been araphid, monoraphid and a biraphid forms classified with use of molecular markers among others in Plagiogrammaceae, Cocconeidaceae, Achnathidiaceae, and Stauroneidaceae.

Keywords: diatoms diversity, molecular markers, Yellow Sea

BIOPROSPECTING FOR OIL IN POLAND WITH DIATOMS

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Ecological and political mandates, though currently not aligned with capital markets, are driving the search for non-edible, renewable biofuels. Alternatives include some vascular plants, but continued focus as been on a wide variety of blue-green algae, green algae and diatoms. With 64,000 described taxa of diatoms, identifying possible target species, and their ability to grow in host countries has become one focus of attention. In this talk we describe the mandates driving the search for non-edible, renewable biofuels, approaches that have been explored to date, and an evolutionary biology approach to identifying possible biofuel production in Poland with local species. This work to help solve 21st century problems is based on integrating more traditional approaches to taxonomy and systematics, with aspects of evolutionary history, ecology and propensity to produce oil.

Keywords: *Amphora*, Baltic Sea, bioprospecting, diatoms, *Halamphora*, renewable energy

EXPERIMENTAL APPROACH TO DETERMINE A TEMPERATURE TOLERANCE FOR THE SELECTED MARINE BENTHIC DIATOMS (BACILLARIOPHYTA) FROM THE SOUTH AFRICA

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Diatoms are the largest group of primary and oxygen producers in the ocean among the Protists and play an important role in the global carbon and silica cycles. They can be found in every aquatic habitats with a little sunlight available. Although the number of described species reaches over 60 000 taxa, still many aspects about their ecological requirements regarding temperature, light or nutrients are uncertain or unknown. Furthermore, the knowledge about the mechanisms affecting or controlling distribution of the diatom communities and individual species in the ocean is also very misty.

The present study aims at resolving the optimum growth temperature for the 10 selected marine benthic diatoms isolated from the open coasts of the Atlantic Ocean (Cape Town, Lamberts Bay, Tsaarbank, 16-Mile Beach-Atlantic view point) as well as from the semi-closed lagoon (Langebaan) in South Africa. Here, the ecophysiological experiments were designed and carried out for 14 days for diatom taxa representing the following genera: *Navicula, Achnanthes, Grammatophora, Seminavis, Hippodonta* to define their temperature tolerance in the series of the temperatures range of 10-22°C. Together with the daily counting records, growth rate, divisions per day and doubling time were also calculated.

It seems that for the selected diatoms the most preferable temperature to grow is between 14-20°C. Our results suggest also that the temperature might be the most crucial factor for the diatom distribution along the South African coasts, especially for the diatoms living in the sheltered Langebaan Lagoon.

Keywords: benthic diatoms, ecophysiological experiments, temperature, South Africa

CRITICAL EVALUATION OF AN INTERCALIBRATION EXERCISE IN DIATOM BASED MONITORING IN POLAND

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Since Poland joined the European Union in 2005, the national law and regulations have been adopted to ensure consistency with other Member States. Significant progress in ecological assessment of aquatic environments has been made following the introduction of the Water Framework Directive. Biological methods based on community diversity and structure has become the principal evidence determining the condition of a water body, replacing ubiquitous physico-chemical measurements. Under the terms of directive, the Member States were required to develop tools for classification of ecological status in rivers and lakes that include among others composition and structure of aquatic flora i.e. macrophytes and phytobenthos. In Poland diatoms were chosen as a proxy for phytobentos. Diatom-based index developed for rivers (IO) addresses eutrophication, organic pollution and deviation from reference assemblages. In lakes, a companion index (IOJ) evaluates eutrophication and deviation from reference assemblages (Picińska-Fałtynowicz & Błachuta 2010).

Since 2007 diatom based monitoring has been conducted by national specialists from Voivodship Inspectorate for Environmental Protection (WIOŚ). In order to evaluate their performance an intercalibration exercise was performed in April 2016. 5 auditors and 48 national specialists participated in this ring test. The intercalibration used slides made from four samples collected from rivers and water reservoirs covering main geographic regions within Poland. Participants were instructed to follow the Polish standard protocol for diatom identification and enumeration (Picińska-Fałtynowicz & Błachuta 2010). The performance of national specialists was evaluated on the basis of IO and IOJ indices according to Kelly (2001).

This talk will show the results and lessons learnt during intercalibration exercise.

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Polski na podstawie badań fitobentosu, Przewodnik Metodyczny GIOŚ, Wrocław, 79 pp.

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Keywords: diatom-based assessment, ecological status, ring test

DISTRIBUTION, MORPHOLOGICAL VARIATION AND PHYLOGENY OF DIATOM (BACILLARIOPHYCEAE) GENUS *OPEPHORA* BASED ON RESEARCH OF THE CLONAL CULTURES

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Taxa belonging in *Opephora*, usually form radiating colonies, are an important component in the marine or brackish water habitats. *Opehora pacifica*, designated as the type species of the genus, is characterized by the absence of linking spines and the presence of large areolae prolonging from the valve face onto the mantle. However, except O. marina and a few undescribed species most of taxa included in *Opephora* do not conform with the above generic characteristic. The true identify of most *Opephora*-like species remain uncertain. To clarify taxonomy of *Opephora* taxa, the living samples were collected from world-wide localities, and single cell were isolated from the natural populations. In our study, twenty-one monoclonal of *Opephora* were obtained, and their morphology was studied with both light (LM) and scanning electron microscopy (SEM). Molecular data allowed a maximum likelihood tree estimation. The tree was based on multiple genes (nuclear-encoded ribosomal small subunit and chloroplast-encoded rbcL and psbC) dataset. Our investigation showed that *Opephora* taxa distributed in a wide range of habitats, such as Indian Ocean (South Africa, Madagascar), Atlantic Ocean (Spain, Canary island, Senegal, Namibia, South Africa), Pacific Ocean (Japan), Gulf of Mexico (Florida, Ward Island), Baltic Sea (Poland, Germany), Mediterranean Sea (Turkey, Croatia) and Persian Gulf (Abu Dhabi). Phylogenetic result revealed that all the *Opephora* clones were non-monophyletic and spread all over the Staurosiroid clade, consisting of *Nanofrustulum, Staurosira, Pseudostaurosira, Staurosirella* and *Punctastriata*. Furthermore, *O. pacifica* clones which is the type species of the genus were distant from the rest of *Opephora* clones in the genetic tree. Based on the molecular result, it was suggested that those *Opephora* taxa, whose character do not fit the diagnostic features of the type (*O. pacifica*), should be transferred to other genera or new genera have to be established to accommodate the remaining taxa.

Keywords: marine diatoms, morphology, *Opephora*, phylogeny

DIATOMS (BACILLARIOPHYTA) OF THE BUNKER VALENTIN IN BREMEN-FARGE, GERMANY

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The Bunker Valentin was submarine factory built as a protective shelter on the Weser River at Bremen, to construct German U-boats during World War II. The factory was damaged by air-raids of the RAF at the end of the war and after the war further bombing of Valentin was carried out to investigate the use of penetration bombs against heavily protected concrete targets.

Studies of diatoms conducted outside and inside of the Bunker Valentin were primarily a floristic. There was no such research before. Specific microhabitats were formed in depressions created after the bombing of the bunker surface, isolated from each other, thereby creating a slightly different environmental conditions (depth, insolation, periodic drying, etc.) that affect the diversity of the diatoms flora. The composition and percentages of the assemblages from different habitats and bioindication properties of diatom species were used to characterize the ecological environment of the Bunker Valentin. During studies on the diatom flora of Bunker Valentin, 11 samples taken in 2013 and 2015 from the water in the craters created after the bombardment of the bunker during and after the Second World War and from the tank located inside the Bunker were analyzed. Differences in surface area, depth, exposure to sunlight, periodic drying, etc., created a variety of microhabitats for diatoms. These microhabitats resulted in a considerable species richness, revealing the presence of 35 genera and 87 species, as well as morphological diversity within analyzed species, especially with the genera of *Achnanthidium*, *Amphora* and *Encyonopsis*.

Keywords: anthropogenic ecosystem, bunker Valentin, diatoms

CENTRIC DIATOMS IN AN IRON ORE POST-MINING RESERVOIRS

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Municipal Reservoirs in Łęczyca were created after flooded iron ore mine. The mine had been operated until early 90s of XXth century. Municipal Reservoirs of Łęczyca consisting of three shallow pond with specific chemical and physical parameters of water i.e. increased pH and conductivity. Benthic, diatomic samples have been collected from Municipal Reservoirs in Łęczyca for two years (from March 2014 to December 2015). Over 190 benthic diatom taxa were indentified. In all analyzed samples, centric diatoms were the most dominant group (over 5% of abundance) i.e. *Cyclostephanos dubius* (dominant species in 96% of samples), *Cyclotella meneghiniana* (dominant species in 54% samples), *Stephanodiscus hantzschii* (dominant species in 50% samples), *S. parvus* (dominant species in 42% samples), *Cyclostephanos invisitatus* (dominant species in 38% samples), *Stephanodiscus minutulus* (dominant species in 17% samples) *Aulacoseria muzzanensis*, (dominant species in 13% samples). In a large population of centric diatoms six species have been classified as a euconstant taxa (*Cyclostephanos dubius, C. invisitatus, Stephanodiscus hantzschii, S. parvus, Aulacoseria muzzanensis, Cyclotella meneghiniana*) and one as a constant taxa (*Stephanodiscus minutulus*).

Keywords: centric diatoms, *Cyclostephanos,* post-mining reservoirs, *Stephanodiscus*

COMPARATIVE ACCOUNT OF DIATOM ASSEMBLAGES IN SEDIMENT CORES: AN INTER- AND INTRA- CORE ANALYSIS FROM INDIAN SUNDARBANS

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Three sediment cores, each of 100 cm collected from different habitats of Indian Sundarbans were studied for determining the composition of diatom assemblages at different depths along a 10 cm interval gradient from the surface till 50 cm depth to study the surface sediment characteristics. The sites differed with respect to their (i) estimated time of build-up/ developmental stage of the land-mass, (ii) distance from the influence of estuarine river and (iii) land-using pattern. Analysis of the diatom communities reveals that the diatom assemblages found at site-1 and the site-2 are similar but the diatom assemblage at site - 3 is different from that found at the sites -1 & 2. Analysis of the diatom communities inhabiting each of the five top layers revealed the dominance of centric diatoms to pinnate forms at both the sites. The calculated ratio of centric to pennate forms of diatoms at site-1 was 31:1 (0-10 cm); 7:1 (10-20cm); 10:1 (20-30cm); 7:1 (30-40cm); 6:1 (40-50cm) and site-2 was 9:1 (0-10 cm); 9.6:1 (10-20cm); 18:1 (20-30cm); 20:1 (30-40cm); 34:1 (40-50cm). But site-3 showed different results due to anthropogenic activity. The vegetation of diatoms found in site-3 is entirely different from site-1 and site-2. In site-1 and site-2 the variation in size rather than morphology is found to be more prevalent in case of the centric forms, whereas the pennate forms revealed higher variations in morphology as compared to size variation. The diatoms forms present in Site-3 showed the reverse result of this. The dominant forms in case of the centric diatoms primarily belongs to the *Coscinodiscus* and *Cyclotella*, occurrence of few *Aulacoseira*, *Pyxilla* have also been noted and in case of the pinnate forms from *Diploneis, Rhophoneis*, *Tabularia*, were found to dominant. In site-3 size variation of the *Eunotia, Nitzschia, Navicula, Gomphonema, Cymbella*, were found.

Keywords: diatoms, estuaries, sediment-core, Sundarbans

POSTERS

AKINETES IN THE RECENT SEDIMENTS OF A LAKE – ABUNDANCE, TAXONOMICAL COMPOSITION AND GERMINATION

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Akinetes are non-motile, dormant cells of cyanoprokaryotes (cyanobacteria) belonging to the traditional orders of Nostocales and Stigonematales. These cells play a crucial role in the dynamics of pelagic population, providing inoculum for population re-establishment after periods of unfavourable conditions, even after many years. The aim of this study was to characterize the akinete pool of the recent sediments of a dimictic lake, in terms of abundance and taxonomical composition. Upper 10 cm of sediments was collected in 2 cm layers. The akinete abundance varied from 70 thousand to 183 thousand per ml of sediments, with the highest akinete number in the upper 2 cm sediment layer. Eight groups of akinete morphological types were identified, some of them easily ascribed to a certain species/genus, other possibly belonging to various taxa. Akinetes were germinated to further clarify taxonomical affinity, and results compared to pelagic population composition.

Keywords: akinetes, dormancy, germination of akinetes, Nostocales

HEAVY METAL TOLERANCE IN DIATOMS FROM THE CONTAMINATED CHECHŁO RIVER (WYŻYNA KRAKOWSKO-CZĘSTOCHOWSKA UPLAND, S POLAND)

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Diatoms play a key role in the functioning of ecosystems. Their sensitivity to many environmental factors, including water pollution with heavy metals, became the basis for the development of indexes diatomaceous for determining the direction of environmental change. The Chechło River accounted for decades the place of discharge mine water from the mine Zn-Pb ores in Trzebinia.

In order to determine the state of the environment in the vicinity of the former mine zinc and lead ore samples were collected in May 2015 from the Chechło River. The concentration of heavy metals and other inorganic substances was determined for water samples. Diatoms were identified to species level with a Nikon Eclipse 80i microscope under 1000× magnification. At least 400 valves were counted for each sample. The taxa with relative abundance higher than 5% were called "dominant". The 95 diatom taxa were identified in the material. The following taxa were dominant: *Achnanthidium minutissimum*, *Cocconeis placentula* var. *placentula*, *Craticula buderi, Eolimna minima, Gomphonema micropus*, *G. parvulum, Hippodonta capitata, Lemnicola hungarica, Mayamaea atomus* var. *permitis, Navicula gregaria*, *Nitzschia capitellata*, *N. palea* var. *debilis*, *Planothidium frequentissimum*, *P. lanceolatum*. Teratological forms of *Achnanthidium minutissimum* and *Fragilaria* ssp. were observed, too.

Our study has demonstrated that under field conditions several diatom species show different patterns of abundance with varying concentrations of heavy metal ions. These are preliminary studies, as a part of the research project designed to investigate the impact of the reducing of the amount of water contaminated with heavy metals. The results obtained may constitute a contribution to identify ways remediation of degraded areas exploitation of metallic ores.

The Research was supported by grant no. 2014/15/B/ST10/03862 from National Centre for Science.

Keywords: diatoms, heavy metals, pollution

THE ECOLOGICAL STATUS OF THE VISTULA RIVER IN TORUŃ, OR TWENTY YEARS OF PHYTOPLANKTON RESEARCH

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The aim of the study was to assess changes in the ecological status of the lower Vistula in the last twenty years. The nineties years of the last century were characterized by dynamic changes in the economy of our country, increased environmental awareness and, finally, the introduction of modern and effective methods of wastewater treatment discharged into rivers. On the other hand the extensive research on modern assessment of aquatic ecosystems was conducted in the first decade of the twenty-first century.

The use of a multimetric phytoplanktonic index for rivers IFPL allows investigate changes of water quality in the Vistula. Vistula's phytoplankton of the nineties was compared with the phytoplankton in the years 2007-2015. The water quality after 20 years has significantly improved. Presently, the average value of the index IFPL is 0.75 and indicates the good ecological status of the waters of the Vistula River in Toruń.

Keywords: centric diatoms, ecological status, phytoplankton, River Vistula

INDICATION VALUE AND BIODIVERSITY OF SELECTED CYMBELLACAE FROM THE WIGRY NATIONAL PARK

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Diatoms are used for bioindication for many years. Trophic conditions are one of the most important factors influencing the freshwater diatom assemblages in rivers and lakes. Various species live in the same environment, but are not adapted to the environmental circumstances. Even closely related species differ from one another in their tolerance ranges, which helps explain their different relative abundances. The identification of their different environmental preferences made it possible to develop water quality assessment methods based on phytobenthic diatoms. Recent studies show that results of lake assessment obtained using the Polish method based on epiphytic diatoms (IOJ the Diatom Index for Lakes) are greatly different from those provided by the other ecological status assessment methods. Due to the fact that Polish Diatom Index overestimates water quality an urgent need of study of several species and their ecology were recognized. The purpose of this study was recognition of Cymbellacae biodiversity in various lakes of the Wigry National Park. Then their ranges of tolerance was preliminary determinate. The material was collected in 2010-2015 from submerged *Phragmites australis*. Until now 25 species were identified. The members of *Cymbella, Encyonema, Encyonopsis* and *Cymbopleura* are common in freshwater periphyton. Some of them are indicated on the Polish red list as rare, eg. *Cymbella helvetica* Kützing and vulnerable *C. aspera* (Ehrenberg) Pergallo. Here we show the results based on the study of six lakes: (Wigry Lake, Krusznik Lake, Białe Wigierskie Lake, Białe Pierciańskie Lake, Muliczne Lake and Okrągłe Lake). Chemical and physical water factors varied there, due to the history of the individual lakes and variation of trophic states, thermal and oxygen conditions, and water exchange. These results are a contribution of the ongoing project concerning diatoms from the Wigry National Park.

Keywords: diatoms, water chemistry, Wigry National Park

UV-INDUCED SYNTHESIS OF MYCOSPORINE-LIKE AMINO ACIDS IN COMMON BLOOM-FORMING CYANOBACTERIA

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The substantial depletion of the stratospheric ozone layer has resulted in an increase in solar ultraviolet radiation on the Earth's surface. UV-radiation is known to have wide ranging impact on photosynthetic organisms including genetic, biochemical, behavioral and ecological effects. Since photosynthetic organisms are simultaneously exposed to visible and UV radiation in their natural habitat, they tend to develop mechanisms counteracting the damaging effects of UV. Cyanobacteria are the oldest oxygenic photoautotrophs on Earth. Their long evolutionary history has enabled development of various survival strategies for instant screening of damaging UVR by UV-absorbing compounds. The most common photoprotective sunscreens in many, but not all cyanobacteria are the mycosporine-like amino acids (MAAs).

In the present study two species of cyanobacteria: unicellular *Microcystis aeruginosa* and filamentous *Nodularia spumigena* have been tested for the presence and induction of ultraviolet-absorbing/screening mycosporine-like amino acids (MAAs). For this purpose cyanobacterial suspensions were for 4 days exposed to radiation consisting of photosynthetically active radiation, PAR+UV-A, PAR+UV-B and PAR+UV-A+UV-B. Conducted research indicates the presence of two substances synthetized by *Nodularia spumigena*: porphyra-334 and shinorine. Surprisingly, there were no MAAs in *Microcystis aeruginosa* samples. The maximum concentration of shinorine in the *Nodularia spumigena* cells was measured in the samples exposed to PAR+UVA+UVB.

Keywords: Cyanobacteria, Mycosporine-like amino acids, UV-radiation

ECOLOGICAL STATUS ASSESSMENT OF ANTHROPOGENICALLY TRANSFORMED STREAMS IN THE CITY OF LODZ

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Many lowland streams flow through the city of Łódź (Central Poland). In 19th Century these streams were used as a sewage receiver for expanding textile and paint industry. Many streams were straightened and transformed to underground flows. Intense urbanization and industrialization has led to degradation of aquatic ecosystems. Raising concern about the water quality of streams resulted in introduction of water quality and ecological status assessment for surface waters. At the beginning, the assessment was based only on physical and chemical factors, which shows the quality status at the time of survey. After joining to the EU and implementation the standards of Water Framework Directive, biological monitoring basing on four groups of organisms, including algae, is being utilized. Biological indicators reflect the ecological status of ecosystems not only at the time of survey, but over the period of time.

Biological monitoring including ichtyofauna, phtobenthos (diatoms), macroozoobenthos and macrophytes is being used since 2004 year. Many research are carried out on municipal streams in Łódź, including: the Łódka, the Sokołówka, the Bzura, the Jasień, the Jasieniec, the Ner, the Dobrzynka. Sampling sites are being located both in the city area and outside the city borders. Such arrangement of the sampling sites allows the assessment of the ecological status of streams throughout their course. Diatom based bio-surveys revel the changes in environmental conditions of ecosystems and allow to determine trends in the ecological state of ecosystems.

The studies conducted so far, revealed that despite the collapse of textile and paint industry, water quality in streams of the city of Łódź has not been highly improved yet. After ten years we are able to see the signs of water quality improvement, but the full recovery of aquatic ecosystems is a slow, longstanding and gradual process.

Keywords: bioindicators, ecological status, streams in Łódź

SEASONAL CHANGES IN ABUNDANCE OF AUTOTROPHIC PICOPLANKTON IN A LAKE OF A HIGH TROPHIC STATE (LAKE KORTOWSKIE, POLAND)

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The aim of the study was to assess seasonal changes in the autotrophic picoplankton (APP) abundance in a lake of a high trophic state. The range of the research included the identification of APP by means of fluorescence microscopy, quantitative analysis of APP cells and calculation of their abundance. Samples were collected from Lake Kortowskie once a month, from April to October 2011, at two research sites. The analysis of the autotrophic picoplankton showed seasonal changes in its abundance for both studied sites. APP abundance was the highest in June (263651 cells/ml) and the lowest in September (3076 cells/ml). In June, the abundance maximum of APP was bigger at the site N (288459 cells/ml) than at the site S (238844 cells/ml). In September, the abundance minimum of APP was smaller at the site S (2692 cells/ml) than the at the site N (3461 cells/ml).

The number of APP was rising from April to June and from September to October and it was declining from June to September. The increase in the abundance of APP between April and May was threefold and from May to June - fourfold. Between September and October, the abundance of APP increased more than tenfold. The increase of the APP abundance was greater at the site S than at the site N from April to May but it was greater at the site N from May to June. Between September and October, the increase of the APP abundance was greater at the site S. The abundance decreased by 40% from June to July. The abundance drop was tenfold between July and August and fourfold from August to September. From June to August, the APP decline was greater at the site N, but from August to September - at the site S. The obtained results allowed us to determine seasonal changes in APP abundance which course can be evaluated as typical for lakes providing similar environmental conditions.

Keywords: autotrophic picoplankton (APP), lake

MID TO LATE HOLOCENE HISTORY OF LONG-TERM MARINE ENVIRONMENTAL CHANGES OF THE SOUTHWESTERN BALTIC SEA REFLECTED IN THE DIATOM RECORD FROM BORNHOLM BASIN SEDIMENT CORES

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Sediments of a long gravity core and complementary short core from Bornholm Basin were studied for their siliceous microfossil assemblages to detect surface water temperature and salinity changes during the mid and late Holocene. Cores were dated using calibrated 14C dates, as well as 210Pb and 137Cs radioisotopes. Simultaneously other sediment proxies, including foraminiferal assemblages, XRF scanning and various geochemistry analyses, were used to provide a comprehensive reconstruction of ecosystem changes. Integrated studies were carried out in the framework of the ClimLink project. The results of the analyses of short and gravity cores focused on the diatom records are presented. The 8 m gravity core and upper 43 cm short cores cover about 7000 cal. yr BP from the transition to Initial Litorina Sea stage to the present. Siliceous microfossils in the gravity core were analyzed in resolutions from 1 to 10 cm, with emphasis on intervals with higher abundances of benthic foraminifera to gain a better understanding of stronger inflows of more saline Atlantic waters. Short core samples were analyzed every 1 cm for more precise dating and better correlation with existing meteorological data. Major changes in siliceous microfossil assemblages (diatoms, Chaetoceros resting spores, Chrysophyta cysts, *Ebria tripartita*, sponge spicules, silicoflagellates) preserved in the core sediments correspond with marine environmental changes during the Litorina–Post-Litorina Sea stages and established cooling–warming events. In the surface layers deposited after ca. 1950–1960 in both sediment cores, diatom assemblages were dominated by planktonic, brackish–fresh to brackish, eutrophic/mesotrophic taxa preferring colder condition. This outcome is the result from rising trophy of the ecosystem rather than only as indicative of a cold climate.

Keywords: Baltic Sea, diatoms, environmental changes, late Holocene

CHARACTERISTICS OF GROWTH RATE AND LIPIDS CONTENT IN THE SELECTED SPECIES OF GREEN ALGAE AND THEIR POTENTIAL USE FOR BIOFUEL PRODUCTION

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Microalgae are a rich source of compounds used in various fields of biotechnology. At present research is focused, among others, on the characteristics of fatty acid profile and lipids production rates in various species, pointing at those that have the potential to be used for commercial purposes. Therefore, the main objective of this study was to determine and compare the growth rate and lipids content of selected representatives of green algae to indicate strains with the greatest potential for the biofuel production.

Green algal strains used for this study were isolated from natural planktonic communities of the Gulf of Gdańsk. Currently, they are maintained, as monocultures in the Culture Collection of Baltic Algae (CCBA) at the University of Gdańsk. The total number of 17 strains was analyzed and their growth rate and lipids content during the exponential growth and in the stationary growth phase were determined.

The results demonstrated that among analyzed species there were three outstanding strains, namely: *Chlorella vulgaris* BA80, *C. vulgaris* BA167 and *Monoraphidium* sp. BA165. Those strains did not show the highest lipids content per cell (i.e. 2.48 pg $cell^{-1}$, 4.89 pg $cell^{-1}$ and 6,26 pg $cell^{-1}$, respectively, as comparing to e.g. *Oocystis submarina* BA1 with lipids content of ca. 16.2 pg $cell^{-1}$), but with the highest growth rates their overall lipids production (i.e.75.90, 80.53; 81.13 mg lipids L^{-1} culture, respectively) was most effective.

Keywords: biofuel production, green algae, lipids

HUMAN IMPACT ON ANTARCTIC TERRESTRIAL ECOSYSTEMS ON AN EXAMPLE OF DIATOMS

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Alien microorganisms, plants and animals have arrived to Antarctic and Subantarctic islands over approximately the last two hundred years, which is related to human activity in this region (Frenot et al. 2005). Nowadays alien macro biota is confined mainly to Subantarctic Region, less likely occur in maritime Antarctic. Current climatic changes will further enhance alien invasion. Humans have introduced a wide range of alien species to Antarctic Region. The main roads entering of alien species include: people movement, cargo connected with Antarctic research and tourism. The study conducted by Whinam et al. (2006) showed that on clothing and equipment of 64 expeditioners 981 propagules and 5 moss shoots were found. The research on soil diatom diversity in the vicinity of the Polish Arctowski Station (King George Island, maritime Antarctic Region) were conducted for a few years. The study area includes glacier forefields on the western shore of Admiralty Bay (Ecology Glacier, Sphinx Glacier, Baranowski Glacier). In more than one hundred samples approximately 120 species were noted. More than dozen of them seems to be cosmopolitan species or taxa very similar to the European diatom flora. The basic question is: it is possible that these species belong to the aliens introduced accidentally in the polar regions?

This hypothesis is confirmed by several facts. Firstly, diatom cell wall built from silica remain in the environment after the death of the cell. Secondly, noted species have been observed in a few samples and always in the form of individual specimens. In Antarctic area penguins (and other birds) can promote for the spread of alien species by e.g. guano.

The hypothesis of the presence of alien diatom species in the Antarctica is difficult to confirm as well as to negate mainly due to the small size of the cells (easy transport) and other factors affecting on soil samples (unclean transport or contamination in the laboratory).

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Keywords: alien species, climat changes, King George Island

PROBLEMS OF WATER BLOOMS IN TROPICAL OLIGOTROPHIC LAKES

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Water blooms of cyanobacteria are commonly associated with high concentrations of nutrients in water, the main crucial factors are concentrations of inorganic N and P. In industrialized, developed countries of temperate regions, inorganic phosphorus is the main limiting element while nitrogen supply in such environment exceeds many times the requirement of primary production. So, cyanobacterial blooms are always connected with high concentrations of phosphorus in water here. However, in tropical regions heavy water blooms of cyanobacteria may occur also in oligotrophic lakes, where concentrations of nitrate nitrogen don't exceed several $\mu g.L^{-1}$, and concentration of inorganic phosphorus reaches relatively high values, so that the Redfield ratio does not reach optimal values. Nitrogen limitation prevents development of phytoplankton assemblages and primary production remains very low. Transparency of such lake can reach more than 10 m and concentration of chlorophyll can be only several $\mu g\ L^{-1}$. However even under such nutrient combinations, water bloom can appear. To our knowledge, only one species of cyanobacteria is able to explore such a niche. It is a filamentous oscillatorialean cyanobacterium *Limnoraphis robusta* Komárek et al., which forms rather large filaments, 18-22 µm wide and several cm long. During last several years, *Limnoraphis* formed heavy blooms in the Lake Atitlán in Quatemala. Specialized portions of its filaments (diazocytes) are able to fix gaseous nitrogen and use it for fast growth when exploring available concentration of phosphorus. We explain situation during the last years and perspectives for future in comparison with situation at the Lakes Amatitlán and Titicaca.

Keywords: cyanobacterial water bloom, Lake Atitlán, *Limnoraphis robusta*, tropic regions

CYANOBACTERIA COMPARED TO OTHER ALGAE IN THE HYPERTROPHIC LAKE IN WIELKOPOLSKA REGION

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Raczyńskie Lake (52 ° 08'36 "N 17 ° 09'56" E) covers an area of 84.4 hectares is one of the numerous lakes in the Wielkopolska Region. It plays an important role in the development of tourism and recreation in the area.

The aim of the study was to analyze the composition of the quantity and quality of phytoplankton in the season from March to October 2015. Water samples were collected from two stations located at the two deepest places of the lake (southern and central parts of the lake), in the vertical section from the surface to the bottom with an interval of 1 m. Samples for biological analysis were fixed with Lugol's solution.

During the studies, 123 phytoplankton taxa belonging to nine taxonomical classes were determined in Raczyńskie Lake. The most of identified taxa were chlorophytes (48%). Less numerous taxa belonged to cyanobacteria - 19%, diatoms - 11%, cryptophytes - 6%, and chrysophytes - 5%.

In the analyzed period phytoplankton of Raczyńskie Lake was characterized by both qualitative and quantitative variability in both localities and at various depths. The minimum phytoplankton abundance was noted in May (850 org. ml^{-1}). The highest abundance were reported in March in the subsurface water layer (43.4 thousand. org. ml^{-1}). Cryptophytes such as *Rhodomonas lens*, *Cryptomonas reflexa*, *C. ovata*, *C. marssoni* and *Rh. lacustris* were dominated than. Chlorophytes, diatoms and cryptophytees were quite abundant in June, especially *Coelastrum astroideum*, *Tetraedron caudatum*, *Scenedesmus communis*, *Tetrastrum komarekii* and *Scenedesmus raciborskii*.

The dominance of cyanobacteria were recorded from July till the end of this studies. The most abundant were *Planktothrix agardhii*, *Aphanizomenon gracile*, *Sphaerospermopsis aphanizomenoides*, *Cylindrospermopsis raciborski* and *Cuspidothrix issatschenkoi*. Cyanobacterial blooms represent a more severe threat to humans, animals, terrestrial and aquatic organisms, and therefore their presence disqualifies the lake as a place for recreation. The priority areas for action is to prevent blooms in the future.

Keywords: cyanobacteria, hypertrophic lake, restoration

EFFECTS OF TEMPERATURE REGIMES AND NUTRIENTS ON THE GROWTH PHASES (TROPHOPHASE) IN *HALAMPHORA* SPP.

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The ecophysiological experiments in the culture conditions have been carried out using three diatom species belonging to the *Halamphora* genus. The species have been isolated from Diaz Point and Walvis Bay in Namibia, and from sediment collected from the nesting grounds of loggerhead turtles in Turkey. The aim of this study was to determine the optimal conditions for growth of the selected *Halamphora* clones. The diatoms were grown in the artificial f/2 culture medium in the several combinations of nutrients content, modified by the various amount of the sodium silicate (Na_2SiO_3), sodium nitrate ($NaNO_3$) and sodium dihydrogen phosphate (NaH_2PO_3). Each clone was inoculated into the six Petri dishes. The effects of a different temperature (18°C, 20°C, 22°C) and the chemical composition of the culture medium on *Halamphora* spp. growth rate and the cell number have been evaluated. The results of the experiments are useful for the bioprospecting of diatom based biofuel production.

Keywords: biofuel production, bioprospecting, *Halamphora*, trophophase

FACTORS AFFECTING SEASONAL AND VERTICAL DISTRIBUTION OF *PLANKTOTHRIX RUBESCENS* IN A DEEP TEMPERATE ZONE LAKE

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The effect of environmental conditions on the distribution of blue-green alga - *Planktothrix rubescens* were carried out in deep, dimictic and mesotrophic Lake Krasne (the West Polesie region, Eastern Poland). The study was conducted, when the mass appearance of this species were occurred, from the beginning of January to the end of September 2010. The samples were always taken from the water surface to 8 m, at one meter intervals, which was the equivalent to euphotic zone during summer. The samples were collected monthly in winter (January-March) and biweekly in the following months (April-September). During studies, the physicochemical parameters at the examined depths, i.e., temperature, Secchi disk visibility, photosynthetic active radiation, electrolytic conductivity and water reaction were measured in situ, whereas, nutrients concentration ($N\text{-}NH_4$, $N\text{-}NO_3$, TN, $P\text{-}PO_4$ and TP) were analysed in the laboratory.

The distribution of *P. rubescens* in the water column depended on months and depth. The highest values of biomass of this species was noted in the upper water layer in winter, just beneath the ice/snow cover, whereas in summer its highest biomass was stated in metalimnion, where this species was responsible for the formation of the deep chlorophyll maximum. When the water column was permanently mixed (spring) the biomass of *P. rubescens* was evenly distributed throughout the water column. The research revealed that the most important factor affecting distribution of this species in the examined water column was light intensity, however, its biomass was also affected by the concentration of soluble and total phosphorus. When the population of *P. rubescens* moved downward the water column the visibility of Secchi disk increased, which was probably amplified by the allelopathic activity of *P. rubescens* that could potentially inhibit the development of algae in epilimnion. Other physicochemical parameters were statistically insignificant but their values were highly differentiated between periods (winter-spring-summer).

Keywords: light intensity, nutrients concentration, phytoplankton biomass

DIATOMS ACCOMPANYING FILAMENTOUS GREEN ALGAE OCCURRENCE IN THE SMALL URBAN RIVERS

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Algological study of diatoms which were co-existed with massive appearance of filamentous green algae in two small, urban rivers were investigated. The aim of the study was to characterized and compared diatoms communities from River Koshkar-Ata which flows through the Shymkent city (Kazkhstan) and River Nielba which flows through Wągrowiec city (Poland). Although, these rivers are located in different geographical areas with different climate, they are similar in terms of: slow flow of the water, muddy sediments, flows through the city and large patches of macroalgae. The samples were collected during spring and summer of 2014 year, at the sampling stations with *C. glomerata* development. The results of the work were enriched with measurement data of *Cladophora* filaments and periphytic diatoms from its thalli and physico-chemical analyses of water parameters were also included.

In both rivers were noted well oxygenated waters and high concentrations of nutrients, total dissolved substance and electrolytic conductivity. According to high trophy the most pollution tolerant genera of diatoms were recorded. The Kazah's river were characterized by the dominance of *Cocconeis placentula*, *Achnanthes biasolettiana*, *Gomphonema olivaceum*, *Navicula laterosrata*, *Meridion circulare*. Representatives of the *Cocconeis placentula*, *Navicula tripunctata*, *N. cryptocephala*, *Hippodonta capitata*, *Achnanthes minutissima*, *Gomphonema parvulum*, *G. olivaceum*, *Ulnaria ulna* and *Nitzschia palea* were numerous in Polish river and play a significant role in the biomass. The biggest differences between the diatoms communities were occurred in the accompanying species. The results also provided clear evidence that the macroalgae *Cladophora* is responsible for the heterogenous microalgal transfer to the water (periphytic algae), with a clear predominance of *Cocconeis placentula* Ehr., *C. pediculus* Ehr., *Navicula cryptocephala* Kütz. in urban rivers.

The potential relevance of diatoms which can be able to respond differently to some environmental factors is in the research field that requires further study of these rivers.

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Keywords: diatoms, urban rivers, water pollution

IMPACT OF PHYSICAL AND CHEMICAL FACTORS ON THE DESMIDS DISTRIBUTION IN A SHALLOW LAKE

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Cyanobacteria and small chlorococal green algae commonly conform for the highest fraction of the microalgal biomass in shallow aquatic ecosystems dominated with submerged macrophytes, although desmids can also be observed in the species composition. The main aim of this study was to estimate the relative contribution of desmids to the total biomass of phytoplankton, and to evaluate the abiotic factors that control the dynamics of these communities. Phytoplankton communities were studied between May and October 2015 in a shallow Lake Oporzynskie, located on the north of Wielkopolska. Physico-chemical parameters, chlorophyll-a concentration and particular groups of phytoplankton were determined in samples collected weekly at the representative sampling sites at the littoral and pelagic zones.

In eutrophic Lake Oporzynskie a spatial and temporal sequence in the composition, abundance and biomass of phytoplankton communities was observed. Most of the species found in the water were well represented by *Scenedesmus* spp., *Desmodesmus* spp., *Pediastrum* spp., *Monoraphidium* spp. and *Willea rectangularis* (A. Braun) John, Wynne & Tsarenko although within of the dominant species in the community were also desmids, like *Cosmarium regnellii* Wille, *C. abbreviatum* Raciborski, *C. botrytis* Menegh. ex Ralfs, *C. leave* Rabenh., *C. meneghinii* Breb. in Ralfs, *C. phaseolus* Breb. in Ralfs, *Closterium tumidulum* Gay, *Closterium strigosum* Breb., *Closterium ehrenbergii* Meneghini ex Ralfs and *Staurastrum gracile* Ralfs ex Ralfs. The contribution of the desmids to the total algal biomass was relevant (7–34%), particularly numerous they were during the development of macroalgal floating mats of *Cladophora glomerata*. Phytoplankton was similar at both sites whereas desmids biomass was significantly higher ($p<0.05$) at the pelagic site, primarily due to better nutrient availability. Ranking of individual abiotic factors was evaluated using statistical analyzes. Our results confirm that desmids can also achieve high species richness and abundance in eutrophic lakes but are still too poorly tested (insufficient data) to show if the scaling is “ecological”.

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Keywords: desmids, freshwater ecosystems

DIATOM ASSEMBLAGES AS AN INDICATORS OF FLOOD DEPOSITS IN GULF OF GDAŃSK

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During the flood of 2010 the range of riverine waters rich in flood suspension reached up to 70 km away from the mouth of the Vistula, and a visible, fresh flood sediment layer was found at the bed. Two cores were collected with the use of a gravity probe in May 2011, from onboard the R/V Oceania, from a depth of 25 m (200 cm long core) and 76 m (226 cm long core) in the Gulf of Gdańsk. Detailed grain size analysis and geochemical analyses (TC, TOC and $\delta^{13}C$) allowed to determine potential layers of flood sediments. The age of the sediments was determined on the basis of the radiocarbon method AMS ^{14}C and ^{210}PB, and ^{137}Cs for subsurface sediments. The goal of this work study was to study diatom structure of flood sediments from 2010 and look for older flood sediments, even from the last few thousand years. The analysis of the species composition of diatom assemblages was carried out according to the Batterbee methodology (1986). In total, 191 diatom taxa were found including 97 freshwater species, 48 marine, 13 brackish, 15 characteristic for both marine and freshwater conditions and 4 characteristic for freshwater and estuarine conditions. Flood sediments from 2010 were dominated by freshwater benthic and planktonic species belonging to *Cyclotella* and *Stephanodiscus* genus, which accounted for 84.5% of total number of frustules. The contribution of marine diatoms did not exceed 13%, with *Thalassiosira* genus being the most numerous. In sediments of deeper parts of cores GC10 and GC11, marine diatoms were mostly represented by genus *Actinocyclus, Thalassiosira* and *Pseudosolenia calcar-avis*, freshwater diatoms by *Staurosirella leptostauron, Pseudostaurosiropsis geocollegarum, Pseudostaurosira brevestriata, Nitzschia constricta* and *Diploneis oblongella.* In potential flood layers, the composition of diatom assemblages was less diverse. Marine and brackish diatoms showed two-three times lower content in comparison to the layers above and below in the profile. Moreover contribution of freshwater diatoms, represented by *Amphora pediculus*, *Cyclotella radiosa, Diploneis oblongella, Placoneis placentula, Pseudostaurosira brevestriata* and *Epithemia frickei* was higher by about 15-20%. The increased abundance freshwater taxa in these layers suggests additional material supply eg. during floods similarly to process reflected in flood deposits from 2010.

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Keywords: desmids, freshwater ecosystems

PHYLOGENESIS AND ULTRASTRUCTURE OF *TRYBLIONELLA HUNGARICA* (GRUNOW) FRENGUELLI IN ATHALASSIC HABITATS

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Study concentrates on diatom species *Tryblionella hungarica* (Grunow) Frenguelli found in an unique hydrogeological area, Central Poland, near to village Pełczyska, Łódź voivodeship. In this region at depth of 1500 m, Zechstein salt is documented. Moreover study area is located at the crossing of the Pełczyska faults. This leads to distinctive feature of the area - presence of spontaneous salt water outflows, originated from boreholes made in 18th century in search of brine. In consequence, a pond occurred next to the outflow, accumulating water from the drilling. Recent diatom based studies are focused on diversity and changes in this vulnerable to climate change environment. In our study we present research on *T. hungarica*, species observed in marine and brackish waters, typical for salt marshes, found also in inland waters environment with high electrolyte concentration and is recognized as tolerant species in case of organic contamination. The morphological characteristics of *T. hungarica* are observed under the light microscopy (LM) and electron microscopy (EM). The phylogeny was estimated based on multiple genes (nuclear-encoded ribosomal small subunit and chloroplast-encoded *rbc*L and *psb*C).

Keywords: phylogenesis, *Trybionella hungarica*, ultrastructure

APPLICATION OF FUNCTIONAL GROUPS FOR EVALUATION OF ASTATIC FIELD PONDS TROPHY

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The trophy of astatic small ponds is definitely affected by local geological, climatic, biotic conditions and the effect of anthropogenic impact In astatic field ponds located on Świecie Plateu we tried to classify the trophy according functional groups method (Reynolds 2002, Padisák et all. 2009). The study was carried in years 2012 and 2013 on two selected reservoirs termed respectively 1 and 2. Fourteen functional groups were recorded: T, Tc, MP, S1, W1, Lo, LM, E, D, Y, X1, X3, J and P. In pond 1, were anthropopression occur (reservoir surrounded by fertilized fields) we observed decreasing water level associated with changing domination of groups. In spring dominated group Y (*Cryptomonas* spp.) Consisting 65% of total algae biomass, followed by domination of D group (*Fragilaria* ssp.) 48%, than during summer dominated group Lo (*Snowella lacustris* (Chod.) Komárek et Hindak,) 92% followed on late summer by group LM (*Microcystis* ssp.). I autumn dominated group E (*Dinobryon* ssp.) consisting 32% of total algae biomass. In reservoir two were no atropopression occurred on spring dominated group D (*Fragilaria* ssp.) 52%, on summer groups T (*Mougeotia* ssp.) and MP (*Ulothrix* ssp.) 92% of total biomass. At the beginning of autumn of 2012 reservoir dried out. Water occurred on late autumn and the group MP dominated (*Cocconeis* sp., *Gomphonema angustatum* (Kütz.) Rab.) Consisting 75% of biomass. Domination of particular functional groups in different period of the year indicates on reservoir trophy changes associated with water level fluctuations.

Keywords: functional groups, phytoplankton, trophic status

DIATOMS AS WATER QUALITY INDICATORS OF SMALL WATERCOURCES IN RZESZÓW CITY

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Studies were conducted on three small streams: Matysówka, Młynówka and Przyrwa flowing through the area of the Rzeszów City. Studied streams have the length about 6 to 12 km. Studied watercourses originate at non-urbanized areas and flow through the city, they are highly regulated. The aim of the study was to assess the water quality and anthropogenic pressure of the investigated watercourses based on diatom indices. Samples from Matysówka stream were collected in 2009–2011, from Przyrwa stream in 2011–2012, and from Młynówka steram in 2014–2015. The water quality of the streams was assessed on the basis of three diatom indices (IPS, GDI and TDI) and also on the %PT indicator. Water temperature, pH and conductivity were measured in situ, during collecting of water samples for detailed chemical analysis. Studied streams were characterized by circumneutral to alkaline water reaction (7,1–8,7), electrolytic conductivity ranged from 300–855 µS/cm and nitrate concentrations ranged from 0,9 to 5,3 mg/l.

The GDI index values classified the studied streams as moderate and poor in term of ecological status of water quality at most studied sites almost in every seasons and every sites. Only in spring in Młynówka at one site water had very good status, whereas in the lower current of the stream this status was bad. IPS and GDI indices showed mostly moderate and poor ecological status on every sites. The lowest values of %PT were recorded in Młynówka stream (6,8–21,5) in 2015, while the highest, reaching over 90% in spring 2009 in Matysówka stream in the middle and lower course. The TDI index at all studied streams always showed worse water quality compared to the IPS and GDI.

Most of sampling sites are under strong anthropopression along almost the whole length. Additionally they are regulated in the middle and lower sections, resulting in a significant decrease of diatom species diversity and water quality.

Keywords: anthropopression, diatom indices, ecological status

CHANGES IN PHYTOPLANKTON MORPHO-FUNCTIONAL GROUPS INDUCED BY EXTREME WINTERS

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The study aim was to compare the structure of phytoplankton of a *Chara*-lake in the growing seasons following extreme winters, in terms of morpho-functional groups. This approach, based on the physiological, morphological and ecological attributes of the species, has proved to be a more efficient way to analyze seasonal changes in phytoplankton biomass. The study was performed in a shallow, mesotrophic *Chara*-lake (Lake Jasne, W Poland). Charophyte vegetation of Lake Jasne covers almost 70% of the lake area. Samples were collected monthly in the pelagic zone in four consecutive growing seasons from 2008 to 2011. Polish Climate Monitoring Newsletters classified the winters as anomalously warm (2007/2008), thermally normal (2008/2009) and very strong (2009/2010, 2010/2011). Considering the above differences in weather conditions as well as other characteristics of winter character, the four studied growing seasons were divided into two periods: I – growing seasons after mild winters 2007/2008 and 2008/2009, and II – growing seasons after severe winters 2009/2010 and 2010/2011.

Comparison of biomass variability of functional groups showed significant differences in the case of groups: C, E and K between the studied periods. Groups K, B, H2, J, Lo and S1 were characterized by higher values of biomass in the period I while groups C, E, MP, N and TB in the period II. Biomass remained on a similar level in the case of groups F, P and T. It is agreed upon that extreme weather conditions are features typical of climate warming, that in waters is reflected in trophycity increase followed by the increase in cyanobacteria biomass. Although in the studied *Chara*-lake higher values of total biomass of phytoplankton were not found in the period I, the cyanobacteria biomass was higher compared to period II. It resulted from higher biomass of groups K (*Aphanothece clathrata*) and H2 (*Dolichospermum lemmermannii*), bringing together cyanobacteria species. The differences were statistically significant in the case of picoplankton cyanobacteria, which are an important component of the phytoplankton in *Chara*-lakes. Unlike in period I, higher biomass of representatives of Heterokontophyta, especially genus *Dinobryon* and *Erkenia* (group E) as well as *Cyclotella* and *Asterionella* (group C) characterized growing seasons after severe winters.

Keywords: climate warming, *Chara*-lake, functional groups, phytoplankton

CELL SIZE-RELATED SPATIAL DISTRIBUTION OF PHYTOFLAGELLATES IN CHARA-LAKE

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In lakes with extensive underwater vegetation, phytoplankton is often dominated by the flagellates, which are able to resist intensified by macrophytes sedimentation from the water column. Additionally, sedimentation is reduced by a high body surface/volume ratio.

The study aimed at investigating the spatial distribution of *Chrysochromulina parva* (Heterokontophyta) and *Plagioselmis nannoplanctica* (Cryptophyta), the species which currently are phytoplankton dominants in a large, postglacial charophyte lake (Lake Lednica, Western Poland), a formerly highly eutrophic waterbody with phytoplankton blooms. A month-to-month variability of abundance, biomass and cell sizes was tested (surface/volume ratio). Samples were collected once a month at three sampling sites within the littoral zone (above the charophyte meadows) and at three pelagic sites (epilimnion) from July to September 2015. Repeated measures ANOVA was applied to elaborate the obtained results. Both, *Ch. parva* and *P. nannoplanctica* are unicellular flagellate forms of wide ecological plasticity, frequently noted in waters of oligotrophic to eutrophic lakes. In Lake Lednica both species dominated in most samples. Higher abundance and biomass of both species were listed at pelagic sites and their peak fell in August. Quantitative differences between the pelagic and littoral zones were the smallest in September. However, the size (length and width) of *Ch. parva* and *P. nannoplanctica* were higher at the littoral than pelagic sites. For the cell length of both species and the width of *P. nannoplactica* differences were statistically significant. For surface/volume ratio, a different patterns were observed for each of the species. For *Ch. parva* higher values were noted in the pelagic zone with decreasing tendency towards September irrespective of the sampled zone. For *P. nannoplanctica* higher surface/volume ratio values were noted in pelagial in July and August. In September, the values were higher in littoral. At the pelagic sites, the ratio values decreased during summer, and, in the littoral zone, the values increased. The results are not in line with expectations, but may suggest that the cell size and surface/volume ratio are less important in preventing falling under the conditions of increased sedimentation than the ability to move, a typical feature of both species studied.

Keywords: *Chrysochromulina parva*, *Plagioselmis nannoplanctica*, spatial distribution

MANAGEMENT OF CATCHMENT BASIN AND AVAILABILITY OF LIGHT IN LAKE WATERS AS THE DETERMINANTS OF SPECIES RICHNESS OF CHARACEAE IN THE LIGHT OF THE OUTCOME OF THE POLISH-GERMAN RESEARCH AND CONSERVATION PROJECT

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The aim of the presentation is to outline the results of a Polish-German project 'The cooperation for the protection of charophyte lakes of Ziemia Lubuska (Poland) and Brandenburg (Germany) regions' conducted by the Adam Mickiewicz University in Poznań, Poland, and the University in Rostock, Germany. The project is funded by the Foundation for Polish-German Cooperation and its main objective is to exchange experiences and information on charophyte lakes of the above regions in order to develop a joint program of protection. Its implementation will enhance knowledge of local communities and authorities to the special status and the sensitivity of these lakes.

In the summer 2015, a comparative study of selected lakes of Ziemia Lubuska and Brandenburg, five lakes in each region, was carried out. Lakes varied in terms of morphology, physical and chemical water characteristics, characteristics of the catchment basin, the use of lakes and forms of protection. What lakes had in common was at least 50% share of charophyte vegetation in phytolittoral area. The study revealed that lakes of Brandenburg are subject to greater anthropogenic pressure, mainly within the catchment area. Thus, the concentrations of total phosphorus were higher in lakes of Brandenburg, while the average concentrations of total nitrogen were similar in both regions. Lubuskie lakes had better light (PAR) availability. All the lakes are under protection, mainly landscape protection. With the exception of Lake Niesłysz, lakes of Ziemia Lubuska region are located within the Natura 2000 areas.

A greater number of charophytes characterized lakes of Ziemia Lubuska (6-11 species) compared with Brandenburg lakes (5-10 species). In all the examined lakes 14 species, representing 4 of 6 genera within the family Characeae and more than 1/3 of the Polish and German charophyte floras, were determined. Water properties support charophyte vegetation and the light conditions are among the key factors for the

charophyte occurrence and species richness. Catchment basin conditions are also of importance, of which an increasing degree of area afforestation is conducive to high-quality waters, in contrast to the surface of the industrialized areas, responsible for poor water quality and low species diversity.

Keywords: Characeae, Chara-lakes, conservation, species diversity

PATTERNS IN VERTICAL DISTRIBUTION OF *GONYOSTOMUM SEMEN* (EHR.) DIESING AGAINST PLANKTONIC COMMUNITIES AND WATER QUALITY IN FIVE SMALL HUMIC LAKES OF WIGRY NATIONAL PARK (NE POLAND)

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Gonyostomum semen (Ehr.) Diesing is an expansive, bloom-forming species which commonly occurs since the end of the last century in humic lakes across Europe. Like many other flagellates, the species has the ability to swim actively, therefore it is often found unevenly distributed in the water column. In July 2015 we carried out research in five small humic lakes situated in Wigry National Park (NE Poland) investigating the vertical distribution of the species population. We also studied the vertical distribution of other planktonic communities (including bacteria, algae, rotifers and crustaceans) as well as physical and chemical parameters of the water (water temperature, oxygen content, pH, electrolytic conductivity, colour, organic compounds content and mineral nutrients concentration). In the studied lakes the species formed the highest biomass in deeper water layers, which corresponds with previous findings from other humic lakes both in Poland and Europe. In the presentation we are discussing the possible relationships between *G. semen* distribution and other studied components.

Keywords: *Gonyostomum semen,* humic lakes, plankton, vertical distribution

CHARACTERISTIC OF THE STRUCTURE OF DENSE MAT FORMED BY *CLADOPHORA GLOMERATA*

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Shallow lakes are characterized by the presence of large algal mat with thicknesses which represent total water depth and could be regularly repeated every year. These algal mats strongly affect on the physicochemical conditions, phytoplankton community and on other organisms in water, and can represent for them a spatially and temporally distinct sub-habitat. Green alga *Cladophora glomerata* (L.) Kütz. was formed a large mats tightly covered the water column of the shallow (2 m) Lake Oporzynskie (N52˚55'; E17˚9'). Samples of algae, water were collected and basic physicochemical measurement were made from the spatial (littoral, pelagic) and the vertical (surface, middle, bottom) profile of the lake. The aim of the study was to investigated vertical and spatial diversity resulting from the mat impact on biotic and abiotic parameters in lake. Temperature, dissolved oxygen and PAR irradiation significantly declined with increasing depth in the mat. The water turbidity was greatest in surface layer than in deeper parts, in contrast to concentration of N-NO3, NH4 and TDS. Pigment content in cell of *C. glomerata*, cell length and diameter of pyrenoids changed from the top to the bottom of the mat. Vertical changes were also related to the phytoplankton structure. Changes in temperature, turbidity and PAR irradiation were also statistically significant between pelagic and littoral zone. Our results show, that in the shallow lake overgrown by *Cladophora glomerata* these macroalgae have a major impact on the vertical physical and chemical factors and phytoplankton distribution.

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Keywords: *Cladophora glomerata*, filamentous green algae, mat

HABITAT VARIABLES OF FILAMENTOUS GREEN ALGAE IN WATER ECOSYSTEMS IN WIELKOPOLSKA PROVINCE (POLAND)

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Cladophora, *Oedogonium* and *Spirogyra* are the most common filamentous green algae (FGA) in lakes, ponds and rivers in Wielkopolska Region. Rapid growth and massive development of FGA is a strategy, which allows achieve dominance in water ecosystems and provide a success in variable habitat and an extension of its ecological niche. However, all species needs for its development a specific set of environmental conditions confirms the niche concept. The aim of the study was investigate ecological niche of common FGA in freshwater ecosystems. To design the habitat niches of filamentous algae GAM's models (Generalized Additive Model) were conducted using the CANOCO.

Response curves of *C. glomerata* from freshwater ecosystems in Wielkopolska Province does not show clear outline to the water temperature gradients , but reveals the decreasing response to increasing temperature, while response of other *Cladophora* species and filamentous algae is completely different. *Tribonema*, *Ulothrix* taxa have their optimum of occurrence in water temperature below 20°C and are called as early spring species. Next, Zygnemataceae (e.g. *Zygnema*, *Spirogyra*) occur in waters with lower content of nutrients, total dissolved substance and electrolytic conductivity than *Rhzioclonium*, *Cladophora* and *Oedogonium* taxa. Model shows, that from Cladophora species, C. glomerata exhibits the strongest response to TDS changes and prefers occurring in water with 200-400 TDS mg L-1. However, *O. capillare*, *C. rivilaris*, *U. variabilis* and *Tribonema* taxa occur in water with the highest electrolytic conductivity (EC) and concentration of total dissolved substance (TDS). Moreover, response of *C. glomerata* on nutrients indicates, that the algae prefers water with higher N, P concentration. Taking into regard all study water parameters, *C. glomerata* occupies a distinct niche in the studied water ecosystems.

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Keywords: GAM models, filamentous green algae, habitat, niche concept

A NEW CHAIN-FORMING PINNULARIA (DISTANTES) FROM JAMES ROSS ISLAND AND VEGA ISLAND (MARITIME ANTARCTIC)

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Recently, a detailed survey of the Maritime Antarctic diatom using a fine-grained taxonomy resulted in the description of many new species belonging to the diatom genus *Pinnularia* in general and the section Distantes, including the *P. borealis* species complex, in particular (Van de Vijver & Zidarova 2011). Recent DNA-based studies of the *P. borealis* complex revealed that molecular phylogenies are highly useful for species discovery and delimitation, suggesting that many more species need to be discovered and described within this complex (Souffreau et al. 2013). During a survey of the freshwater littoral diatom flora of James Ross Island and Vega Island (Ulu Peninsula, Maritime Antarctic) an unknown chain-forming Distantes taxon belonging to the *P. borealis* species complex was observed. Several cultures of the new species were established from four different localities. Molecular phylogenies based on D1-D3 LSU rDNA and rbcL revealed that all cultures belong to a distinct highly supported lineage in the *P. borealis* species complex. The new species is morphologically characterized by the presence of small spines located on a raised, thin silica ridge that almost entirely surrounds the valve face near the valve face/mantle junction and the presence of small silica plates near the apices. In culture, the new species forms chains of several tens of cells and in oxidized natural material, chains up to seven frustules have been observed. The new species is described from the littoral zone of freshwater Black Lake in James Ross Island. Although *P. borealis* is generally regarded as a semi-terrestrial diatom complex which is mainly occurring in (moist) soils and mosses, the new species seems confined to freshwater habitats with an alkaline pH and low conductivity values.

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Keywords: Antarctica, Diatoms, new species, *Pinnularia*

LORICA DEVELOPMENT IN EUGLENOID *TRACHELOMONAS HISPIDA*

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Cells of euglenoid *Trachelomonas* form external envelopes (loricae) saturated mainly by iron and/or manganese compounds and they have rigid structure. These envelopes vary in size, shape and appearance of the external ornamentation. The appearance of loricae – their shape, the presence or the lack of a collar or thickening surrounding the apical pore as well as the external structure of envelopes is still used as a principal criterion in species identification. Lorica of *Trachelomonas hispida* is oval, with apical pore surrounded by spines or collar. Ornamentation includes the possession of pores and spines.
In the studies that have included loricae of axenic culture of *Trachelomonas hispida* (CCAP 1283/8) obtained from the Culture Collection of Algae & Protozoa, Dunstaffnage Marine Laboratory, Oban, Scotland, UK, we observed loricae on different stage of development. At first, the loricae were very thin, densely reticulate, afterwards the cells form solid, thick wall of granular structure with small pores. In this stage the envelope wall seems to be bilayered, including inner, reticulate region and outer, granular region. At the end loricae slightly changed their shape and became somewhat wrinkled. The wall of loricae was becoming reticulate again, with very large perforations. Apart from different structure of the envelope wall, some of loricae formed collar or spiral folds around the apical pore. Some of them, additionally, possessed a small projection at the posterior end, whereas others were broadly rounded. A SEM investigation showed differences in chemical composition of *Trachelomonas hispida* loricae depending on the structure of loricae (granular or reticulate). Regardless of envelope structure however, Fe was the major mineralizing element. The laboratory research showed how large morphological variability within one species may be observed.

Keywords: euglenoids, lorica, *Trachelomonas*

MOLECULAR PHYLOGENETIC ANALYSES OF *ENTEROMORPHA*-LIKE ULVA (ULVACEAE; CHLOROPHYTA) FROM POLISH PART OF BALTIC SEA

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The current study focused only on populations of *Ulva* species occurring in polish part of Baltic Sea. In this work, we present a comprehensive study of marine *Enteromorpha*-like *Ulva* populations. The differentiation of marine *Ulva* taxa was assessed using molecular techniques, including sequencing of the nuclear internal transcribed spacer region (ITS1-5.8S-ITS2) and the chloroplast rbcL gene. The ITS and 5.8S rDNA regions were sequenced for 33 specimens of *Enteromorpha*-like *Ulva* collected from 10 stands across polish part of Baltic Sea (Gdynia, Hel, Kołobrzeg, Mielno, Międzyzdroje, Rozewie, Sianorzety, Sopot, Swinoujście, and Władysławowo), including 4 specimens from Germany (Ahlbeck, Heringsdorf, Bansin, and Zinnowitz), as well as 2 samples from Netherlands (Bornholm (Rønne) and Christiansø).

We found that only 4 species of *Enteromorpha*-like *Ulva* exist in polish part of Baltic Sea: *Ulva compressa* Linnaeus 1753: 116, *U. flexuosa* Wulfen 1803: xxii, *U. intestinalis* Linnaeus 1753: 1163 and *U. prolifera* O. F. Müller 1778: 7. On the basis of analysis of ITS region and rbcL gene sequences, a small degree of differentiation of *U. compressa*, and *U. intestinalis* species was found. The two most common species are *U. intestinalis* and *U. compressa*. Both species occurred in all investigated stands and were always found coexisting. *Ulva prolifera* was found at two sites: Świnoujście and Władysławowo. *U. flexuosa* was found only at Mielno.

Keywords: *Enteromorpha*-like Ulva, macroalgae, Baltic Sea, phylogeny

HUMIDOPHILA AND *DIADESMIS* GENERA – MORPHOLOGICAL VARIABILITY IN ATYPICAL HABITAT

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Studies were carried out in October 2014 and March 2015 inside the Solina Dam, and on Wołosaty stream (left-side tributary of the San River) and its tributaries: Wołosatka and Terebowiec. Solina Dam is one of the two dams, which separated San River, the main river at the territory of Podkarpackie voivodeship. The dams Solina and Myczkowce were built in the 1960s in order to flooding control of the low-lying areas and for harnessing the power of the falling water for the production of renewable energy, and together constitute hydroelectric power plant complex. Inside the Solina dam material to studies were collected from the communication and control corridor (called the "gallery"), which is open for tourists, from drainage channels using a pipette and scraped from wet walls using a plastic spatula and from stones in streams: Wołosaty, Wołosatka and Terebowiec. The basic water parameters were measured in situ (pH, conductivity, dissolved oxygen and temperature of the water). Detailed chemical analyzes were made in the Departmental Laboratory of Analysis of Environmental Health and Materials of Plant Origin. Diatom samples were preserved in a 4% formalin solution. In order to obtain pure valves of diatoms a part of the obtained material was prepared according to the methods applied by Kawecka. Diatoms were identified and counted under a Carl Zeiss Axio Imager A2 light microscope and under a Hitachi SU 8010 at the Podkarpacie Innovative Research Center of the Environment (PIRCE) at the University of Rzeszów.

During the studies *Humidophila contenta* (Grunow) Lowe, Kociolek, J.R.Johansen, Van de Vijver, Lange-Bertalot & Kopalová, *H. perpusilla* (Grunow) Lowe, Kociolek, Johansen, Van de Vijver, Lange-Bertalot & Kopalová, *Humidophila* sp. and *Diadesmis gallica* W.Smith were noted. The first two species created the most abundant communities in Solina dam, and they had varied morphological forms. *D. gallica* occurred in raphe-less forms. In every studied streams all investigated species occurred as individual specimens, except *Diadesmis galica*, which was recorded only in Solina dam.

Mentioned species prefer sub-aerial biotops or terrestial habitats, like as wet rocks, soil or mosses. They are cosmopolitan and wide spread species.

Keywords: *Diadesmis, Humidophila,* Solina, Wołosaty

RECOVERY OF SHALLOW LAKE FROM CULTURAL EUTROPHICATION IN THE LIGHT OF CLIMATE CHANGE

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Anthropogenic nutrient enrichment and climate change are the major causes of excessive proliferation of cyanobacteria. Eutrophic shallow Lake Širvys (Lithuania) has suffered from almost annual cyanobacteria blooms over the last two decades due to pollution induced by the farm situated nearby. The farm was closed a decade ago, and the nutrient input from the basin decreased substantially, so the recovery of the lake ecosystem has been expected. The aim of this study was to assess alterations in cyanobacteria species composition, biomass and cyanotoxin concentrations in relation to changes of nutrients amount and climate variables (water and air temperature, rainfall) within a short-term period.

The studies performed in 2009 and 2014 demonstrated the increase of average annual and summer air temperature by 1˚C, precipitation decreased by 23% in 2014. Mean annual phytoplankton biomass reduced by 2.5 times, but cyanobacteria percentage in the community did not change (~55% on average). The maximum biomass was recorded in autumn in both study years, particularly up to 40 mg/l in 2009 and 21 mg/l in 2014. The dominant species remained the same during the years of investigations and non-diazotrophic *Planktothrix agardhii* comprised up to 98% of phytoplankton biomass. Although the average inorganic phosphorus concentrations decreased three times, inorganic nitrogen increased over three times and the N:P ratio was almost 1.5 fold greater in the lake from 2009 to 2014. Phosphate seemed to be a crucial factor for cyanobacteria proliferation (R = 0.794, p 0.01). Furthermore, it positively correlated with *P. agardhii* and *Aphanizomenon gracile* (R = 0.594 and R = 0.794, respectively, p 0.05). The cyanotoxin concentrations were assessed by ELISA method. Relatively high concentrations of microcystin were found. Also, the negligible amount of saxitoxins was recorded and *A. gracile* was suspected to be a potential producer.

Although the improvement of water quality was recorded in the lake, trophic level of Lake Širvys hasn't changed. The internal loading of nutrients from the sediments, global climate change likely support harmful cyanobacteria dominance till nowadays.

Keywords: cyanobacteria, microcystin, *Planktothrix agardhii,* saxitoxin

THE EPIPHYTIC DIATOMS ON *CHARA* SAMPLES IN TURKEY

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Regarding the study of specific diatom communities, diatoms from lakes have received more attention and that, within lakes, phytoplankton studies are significantly more numerous. On the other hand, epilithic, epipelic and epiphytic communities are represented with similar number of references each. In the case of rivers, epilithic and epipelic communities received more attention, while the number of references for epiphytic communities are fewer.

Among the epiphytic samples, *Chara hispida* (L.) Hartm. is important because the species is widespread and relatively common in Europe. However, this mainly European species was found in the European and Asian parts of Turkey. The Turkish localities are marginal in terms of distribution range and the frequency of occurrence. Therefore, the morphology and ecology of *C. hispida* from these border habitats deserve special attention to reveal the ranges of morphological and ecological variability and to create verifiable and reliable records of the species. Also, another diatom communities were investigated on some widespread *Chara* samples. The samples were collected from river catchments in Turkey (Büyük Menderes, Sakarya and Konya river catchments). As a result, totally 182 diatom species were found on *Chara* samples.

This study was partly supported by TUBITAK-114Z006.

Keywords: *Chara*, diatom, Turkey

IMPACT OF GLYPHOSATE ON MICROPHYTOBENTHOS COMMUNITIES OF THE GULF OF GDAŃSK IN TOXICITY TESTS

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Understanding the impact and negative effects of glyphosate interaction with non-target organisms is extremely important, because in the past the toxicity of many applied pesticides was incorrectly assessed, which consequently led to a number of irreversible changes in the environment. Glyphosate has been used in agriculture since 1971, and it is the main component of the world's most widely used herbicide – Roundup®. In recent years, the popularity of this herbicide has increased with spread of crops of genetically modified organisms (GMO) resistant to glyphosate. The study comprised testing of Roundup® impact, wherein the active ingredient was glyphosate. Microphytobenthos was collected from experimental panels exposed for 14 days in the coastal zone of the Gulf of Gdańsk in July 2015. The developed communities were transferred to the laboratory, scraped and homogenized, and then acclimated for 72 h. The effect of glyphosate at two concentrations was tested for a period of 7 days. The assessment of the condition of microphytobenthos communities involved the use of frequent indicators of community condition such as: abundance, community biomass, concentration of photosynthetic pigments and maximum efficiency of photosystem. A new and so far rarely used indicator used in the study was the change in the shape of chloroplasts in microphytobenthos cells. During the experiment, changes in the structure of communities, as well as a decrease in count and biomass upon the application of glyphosate, were observed as early as from the first day. In the test communities, the concentration of chlorophyll a also decreased over time. Glyphosate negatively affected the maximum efficiency of the photosystem, after seven days at a concentration of 8.5 g·dm^3 a 50% smaller value of this parameter compared to the control solution was observed. Glyphosate at a concentration of 8.5 g·dm^3 as early as from the first day caused an increase in the number of cells with damaged or dead chloroplasts. Based on the obtained results it was demonstrated that glyphosate in the form of Roundup® product negatively affects microphytobenthos communities, and induced changes can be traced both at cellular and population level.

Keywords: communities, diatom, ecotoxicology, glyphosate, microphytobenthic

PECULIARITIES WITHIN CRYPTOPHYTES IN ANTHROPOGENICALLY TRANSFORMED POND IN DRWĘSA (MID-WESTERN POLAND)

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The aim of the study was to analyse the composition, abundance and biomass of cryptophytes in a pond in the village of Drwęsa near Poznań (Wielkopolska Lakeland, Poland). This water body is small (area 0.03 ha) and shallow (max. depth 1.9 m) and was formed as a result of deepening of a small depression for retention of rainfall from the village. This pond is still strongly influenced by human activity. In 2008, experiments in mesocosms were performed to inactivate phosphorus compounds. The next year added to the water microbiological preparation containing effective microorganisms (EM). Moreover, in the period 2010-2015 submerged macrophytes were removed repeatedly. The study of phytoplankton was carried out from 2011 to 2015. Samples of water were collected from the surface (0.2 m), several times a year. Cryptophytes were identified by microscopic observations of living specimens and of samples preserved with Lugol's solution. Algal abundance was calculated under an inverted microscope after sedimentation in 14-ml chambers and the cell volume of each species was calculated on the basis of cell shape and size. Cryptophytes more often dominated in respect of biomass than in respect of abundance and usually exceeded the value of 2 mg/l. In comparison with other water bodies of the Wielkopolska Lakeland and Poland, the cryptophyte species composition was unique because of the presence of *Cryptomonas undulata* Gervais which was recorded in Poland only once before. Previously, *C. undulata* was found in a gravel pit lake in Owińska situated in the suburban area near Poznań. This species lives in the summer chemocline near the oxic-anoxic boundary but in shallow pond in Drwęsa appeared in the surface layer of the water when the water level was low.

Keywords: *Cryptomonas undulata*, cryptophytes, ponds, Wielkopolska Lakeland

SEASONAL FLUCTUATIONS OF PHYTOPLANKTON IN STRZESZYŃSKIE LAKE IN THE RELATION TO ENVIRONMENTAL FACTORS DURING THE FOURTH YEAR OF LAKE RESTORATION

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The seasonal dynamics of phytoplankton under human impact was studied in the natural Lake Strzeszyńskie (area about 35 ha, max. depth 17.8 m, mean depth 8.0 m). The lake is located in Poznań Lakeland, within the city of Poznań (mid-western Poland). Due to water quality deterioration it has been subjected to restoration since 2012 by means of phosphorus inactivation methods in open water. The main aim of the study was to analyse the composition and structure of phytoplankton with reference to physicochemical parameters of water. Water samples were collected from the deepest, southern part of lake between March and December 2015 (usually once a month) and at the same time selected environmental parameters (water temperature, transparency, conductivity and pH) were measured. Algae were analysed under an inverted microscope after sedimentation in 14-ml chambers and the biomass was estimated as chlorophyll-a concentration. Physicochemical analyses included: total, mineral and organic forms of nitrogen and phosphorus. The phytoplankton community structure changed significantly with seasons. In spring the most important groups of phytoplankton were the Cryptophyceae and/or Bacillariophyceae whereas in summer and autumn the abundance of Chlorophyceae, Cyanobacteria and/or Cryptophyceae were high. The most numerous cells were of centric Bacillariophyceae (*Cyclotella ocellata* Pantocsek), filamentous Cyanobacteria (*Pseudanabaena minuta* Skuja), small-sized or colonial Chlorophyceae (*Scenedesmus brevispina* (G.M. Smith) Chodat, *Chlorella* spp., *Coelastrum* spp.) and also Cryptophyceae, especially *Cryptomonas* and *Rhodomonas* species. The biomass of phytoplankton, expressed as the concentration of chlorophyll-a peaked in late March (20.4 ug/l), late June (11.9 ug/l) and July (11.6 ug/l), whereas in late May, late September and mid-December it was low (about 3 ug/l or less). Total phosphorus concentration in upper and in deeper water layers varied between 0.001-0.166 mg P/l and 0.012-1.993 mg P/l, respectively. Among the analysed forms of mineral nitrogen, clearly ammonium prevailed. Soluble phosphorus exceeded 100 ug P/l only in the hypolimnion in late June,

July and October. Statistical analysis reveals only few significant relationships between physicochemical parameters and the biomass of phytoplankton. This suggests that due to restoration the biotic factors are more important regulators of phytoplankton dynamics in this lake than nutrients are.

Keywords: chlorophyll-a, lake restoration, nutrients, phytoplankton,

ALLELOPATHIC EFFECTS OF PICOCYANOBACTERIUM *SYNECHOCOCCUS* SP. ON BALTIC FILAMENTOUS CYANOBACTERIA

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Allelopathy may be one of the factors contributing to the formation and maintenance of cyanobacterial blooms (Suikkanen et al., 2004). The increasing cyanobacterial blooms are changing the structure of the aquatic communities in the Baltic Sea (Stal et al., 2003; Suikkanen et al., 2005). Generally, the blooms of cyanobacteria that develop each summer in the Baltic Sea are composed of two different groups: the large, colony-forming, filamentous cyanobacteria and small-sized picocyanobacteria (Mazur-Marzec et al., 2013). However, the impact of allelopathic compounds produced by Baltic picocyanobacteria on filamentous cyanobacteria remains unknown.

In this study the influence of allelopathic activity on the filamentous cyanobacteria *Nostoc* sp., *Rivularia* sp. and *Aphanizomenon* sp. was investigated by single and repeated addition of a cell-free filtrate of picocyanobacterium *Synechococcus* sp. In this work, the influence of allelochemicals on the growth, chlorophyll a fluorescence, photosynthesis irradiance curves, pigment contents and fatty acid production was investigated.

These studies indicate that the picocyanobacterium *Synechococcus* sp. reveals allelopathic activity on the analyzed filamentous cyanobacteria. Addition of cell-free filtrate from *Synechococcus* sp. cultures inhibited *Nostoc* sp. and stimulated *Aphanizomenon* sp. Moreover, the study showed that *Synechococcus* sp. had no allelopathic effect on growth, photosynthesis and fatty acid production of *Rivularia* sp. However, after the cyanobacterial free-filtrate addition, the minimum response of chlorophyll a content of *Rivularia* sp. was 31% lower, than for control. To evaluate the significance of the phenomenon of allelopathy, there is a need to study the varied factors affecting the production and secretion of active allelopathic compounds in more detail. Providing new information on the extent of the effect of allelopathic cyanobacteria may also be important for a better understanding of the worldwide intensifying phenomenon of the emergence of massive blooms of cyanobacteria in many aquatic ecosystems.

Keywords: allelopathy, cyanobacteria, growth, *Synechococcus* sp.

DEVELOPMENT OF EPIPHYTIC ALGAE ON COMMON REED (*PHRAGMITES AUSTRALIS*) IN FOUR MODIFIED LAKES BEING A PART OF THE WIEPRZ-KRZNA CANAL SYSTEM: EFFECT OF TROPHIC CONDITIONS AND FISH PRESSURE

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Epiphytic algal communities are an important component of aquatic ecosystems, but they have received relatively little attention and have been studied far less often than phytoplankton. We investigated the species richness, diversity, abundance and biomass composition of epiphytic algae inhabiting common reed in the meso-eutrophic Lake Skomielno, the eutrophic/dystrophic Lake Czarne Sosnowickie, the eutrophic Lake Tomaszne and the hypertrophic Lake Krzczeń (TSIave. = 51; 65; 67; 80; respectively). The lakes are periodically supplied by nutrient-rich canal waters and differ in fish management. Samples of lake waters, reeds and fish were collected three times in 2012, in the littoral zone of the reservoirs.

The results revealed that algal species richness decreased from 94 taxa in the meso-eutrophic lake to 64 in the hypertrophic reservoir. The Jaccard index (J=0.29-0.37) showed low species similarity of algal assemblages between the lakes. Algal abundance and biomass were lower in the meso-eutrophic and hypertrophic lakes (mean values of abundance: 2.59x105 and 3.48x105 ind. cm^{-2} of reed) than in two eutrophic reservoirs (5.25x105 and 7.18x105 ind. cm^{-2}). Both the abundance and biomass composition of algae varied between lakes and seasons (except Lake Czarne). Generally, pennate diatoms predominated in the total algal abundance in all lakes, while in the biomass predominance of diatoms (in Lakes Skomielno and Krzczeń) and filamentous Chlorophyta (in Lakes Tomaszne and Czarne) was found. The abundance of fish (potential algal grazers) was the lowest (10-22 CPUE) in Lake Skomielno and the highest (95-336 CPUE) in Lake Krzczeń, in which fish composition was the most diverse (high share of four fish species). In other lakes roach (*Rutilus rutilus*) predominated. Redundancy analysis (RDA) showed that all the environmental variables accounted for 80.4% of the total variance in the algal composition, and the most significant were the DIN/DIP ratio (dissolved inorganic nitrogen and phosphorus) and water transparency. RDA also revealed the importance of fish pressure; the most significant was rudd (*Scardinius erythropthalmus*), which abundance and pressure was the highest in the hypertrophic lake.

Factors shaping epiphytic algal communities are very complex. In anthropogenically modified lakes, trophic conditions and fishery management may essentially influence the epiphytic algal assemblages.

Keywords: algal abundance and biomass, algal diversity, fish pressure ,TSI index

DIVERSITY OF PLANKTON ORGANISMS IN SHALLOW RESERVOIRS EXPOSED TO CYANOBACTERIAL BLOOMS

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Biodiversity is defined as species richness, which represents the total number of species in a specified place and time. Because biodiversity is defined as a value, it is important to understand the risks that might cause decreasing it. Biodiversity determines the stable functionality of ecosystems, thus, it is necessary to maintain biodiversity at a high level. Each ecosystem contains specific trophic (inter-species) connections, therefore, it is obvious that ecosystems begin to be weakened by a decrease in species diversity. The main cause of decreasing water biodiversity is significant anthropogenic pressure, the degradation of water ecosystems, and habitat loss due to the high modification and fragmentation of the landscape. The effects of anthropogenic pressure on water ecosystems is well known as 'anthropogenic eutrophication', which results in cyanobacterial blooms. These blooms modify the properties of water, such as oxygen saturation, nutrient loading and the presence of cyanobacterial toxins, which might be harmful to water organisms. The hypothesis is that in water systems with heavy and long lasting cyanobacterial blooms, diversity of planktonic organisms (phytoplankton, ciliata, zooplankton) decreased. Studies were taken during the 2014-205 years in four shallow Vistula's oxbow lakes, and two artificial shallow reservoirs located in Krakow. Blooms were created by different species of Cyanobacteria: *Microcystis aeruginosa*, *Aphanizomenon flos-aquae, Anabaena flos-aquae*. In two oxbow lakes we did not find microcystins in water but in remain two and artificial reservoirs microcystins were present but fluctuated during the time of blooms. However, we did find only weak statistically correlation between concentration of microcystins in water and biodiversity of planktonic components (algae, ciliata, zooplankton) but we want to paid special attention to the complexity of interactions (synergistic interactions) between toxins, abiotic factors and biodiversity.

Keywords: cyanobacteria, harmful blooms, phytoplankton, toxins

THE PHYTOPLANKTON COMMUNITY DYNAMICS IN LAKE CHARZYKOWSKIE IN RELATION TO PHYSICOCHEMICAL CONDITIONS

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Long-term observations of the species composition, structure, biomass and concentration of chlorophyll-a in the phytoplankton of Lake Charzykowskie indicated long-term fluctuating changes (Wiśniewska, Luścińska 2012). The objective of the detailed studies carried out in 2014 and 2015 was to verify the previous observations and conclusions. The list of species together with their assigned functional groups (characteristic of specific environmental conditions), proposed by Reynolds et al. (2002), was used in the analysis of comprehensive phycological material. The current research has shown that the phytoplankton community structure does not significantly change in the limnological cycle. Diatoms from the functional group P and C dominated in spring during the studied period. Diatoms belonging to this group: *Aulacoseira granulata* (P), *Asterionella formosa* (C) and *Fragilaria crotonenis* (P) constantly occur in Lake Charzykowskie. Whereas the spring dominance of C-strategist *Plagioselmis nannoplanctonica* from the functional group X2 is characteristic of well-mixed meso-eutrophic lakes.

Species from the functional group LM − *Microcystis aeruginosa* and *Ceratium hirundinella* − co-dominated in the summer plankton in 2014 and 2015. At site 2 (the central basin of the lake), *Gloeotrichia echinulata* (H2) dominated in summer. *Aphanizomenon flos-aquae* from group H1 maintained a relatively high percentage in the late autumn phytoplankton. Each autumn, the structure of the phytoplankton community is modified and dominated by diatoms and cryptophytes. It has been found that algal blooms in Lake Charzykowskie caused in the 1980s by cyanobacteria *Microcystis* sp. div. and *Aphanizomenon flos-aquae* are now sporadic and short-lived.

During the studied period, the biomass of phytoplankton remained at a low and moderate level, i.e. from 0.5 $mg.dm^{-3}$ to the maximum value of 18.42 $mg.dm^{-3}$ recorded between late July and early August in 2014. The concentration of chlorophyll-a in the phytoplankton ranged from 2.35 $\mu g.dm^{-3}$ to the maximum of 21.31 $\mu g.dm^{-3}$.

At the same time, the analysis of physical and chemical parameters of water shows good conditions for the phytoplankton growth and very unfavourable aerobic conditions. In the summer, the total oxygen depletion was recorded already at a depth of 6-7 m.

Keywords: biomass, functional groups, lake, phytoplankton

PLANKTONIC ALGAL ASSEMBLAGES IN PONDS OF DIFFERENT TROPHY AND CATCHMENT CHARACTER

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The study on algal assemblages was carried out on small water bodies (ponds) located in the vicinity of Jonkowo in the Warmia and Mazury Region (N-E Poland). Samples were collected seasonality (April, June and October) in 2010 at ten ponds of different catchment: village (VLP), fish (FIP), meadow (MEP), forest (FRP) and fields pond (FLP). The aim of this study was to determine the differentiation of algal assemblages as related to physicochemical water parameters in ponds of different trophy and catchment character. In this study was recorded the following differences in water parameters: (1) the lowest water temperature (15.3°C) and oxygenation and the highest conductivity and P-PO_4 (2.29 mgl^{-1}) in MEP; (2) the highest water temperature at 18.8°C in VLP; (3) the highest oxygenation (7.35 mgO_2l^{-1}) and the lowest conductivity in FRP; (4) the lowest pH and P-PO_4 and the highest NH_4 (0.22 mgl^{-1}) in FLP and (5) the lowest NH_4 and the highest pH in FIP. This study also demonstrated the qualitative and quantitative differentiation of algal assemblages. The lowest abundance and biomass was found in MEP (2672 $ind.ml^{-1}$ and 0.02 $mgml^{-1}$) and the highest in FIP (187810 $ind.ml^{-1}$ and 0.43 $mgml^{-1}$). CCA analysis shows the largest similarity between algae in MEP and FLP, while the most distinguished was in FRP. These assemblages were dominated by chlorophytes, cyanobacteria and diatoms. Chlorophytes and cyanobacteria were positively correlated with T and P-PO_4, whereas diatoms with O_2 and NH_4, and negatively correlated with water temperature. Cyanobacteria were represented by *Aphanizomenon gracile*, chlorophytes by the genera *Chlamydomonas* (all ponds) and *Spirogyra* (FRP), the species *Closterium cynthia* (FRP, FLP), *Closterium echrenbergii* (MEP, FLP), *Pediastrum duplex* and *Monoraphidium concortum* (VLP), *Ulothrix tenuissima* (MEP) and *Pediastrum boryanum* (FLP); and diatoms by the genus *Pinnularia*, *Fragilaria capucina* (MEP) and the species *Diatoma vulgaris* var. *linearis* (FRP) and *Diatoma vulgaris* (VLP, FLP). These algal assemblage differentiation was related to the catchment character including nutrient inflows (especially phosphorus and nitrogen), morphometry of water bodies (area, deep), and also external factors e.g. high water temperature, falls and evaporation.

Keywords: algal assemblages, nutrients ponds

MORPHOLOGICAL AND GENETIC VARIATIONS OF CHAROPHYTE *CHARA BALTICA* A. BRUZELIUS 1824 IN PUCK BAY (SOUTH BALTIC SEA)

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Chara baltica is a charophyte species widely distributed in the Baltic Sea and the dominant component of the coastal phytobenthos in Puck Bay. This species is characterized by large morphological variability. Differentiation refers mainly to the size of the thallus and the resulting different metric size ratio of its individual elements. There are four different forms identified in the Baltic: *Ch. densa*, *Ch. breviaculeata*, *Ch. liljebladii*, *Ch. baltica* (Blümel 2003). In the Gulf of Gdańsk Lakowitz (1929) identified three forms, including one described as a new one: *Ch. macroteles* Migula, *Ch. simplex* Migula and *Ch. brachyphylla* Lakowitz. Clearly 2-3 morphological types of *Chara* were distinguished in course of our studies. Results showed wide range of differences in quantitative characters between *Ch. baltica* varietes and within two of them were the most significant. Naming the varieties is made with caution because many authors treat the genus *Chara* in different manners. However, morphological types found in this study match with varieties description made by Lakowitz (1929) rather than to those made by Blümel (2003). Further, there has been also a number of transition forms noted.

Herbarium samples from our collection were used for DNA studies. DNA barcoding was used to identification by assigning individuals to known taxa through comparison of their barcodes with a reference library. We used rbcL + matK as the standard plant barcode. Primers were derived from Schneider et al. (2015), Kress and Erickson (2007), Levin et al. (2003). Analyzed *Chara* varieties seem to be genetically closely related and can be considered as ecotypes or local adaptations. Nevertheless, morphological traits such as number and length of spine cells, stipuloides and bract cells are still traditionally used for identification of *Chara* taxa (Schneider et al. 2015).

Keywords: *Chara baltica*, Puck Bay

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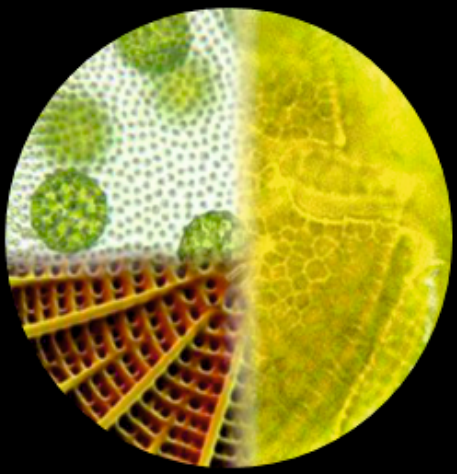

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