Attachment 2b

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## SUMMARY OF PROFESSIONAL ACCOMPLISHMENTS

# 1 Name and last name

Anna Jadwiga Czaplicka

# 2 Acquired diplomas

1990 **Master Degree in Geology**

Master studies (1985-1990):

AGH University of Science and Technology in Cracow, Faculty of Geology and Mineral Exploration, speciality: Geology of Salt and Chemical Resources

Master thesis in Polish: “Budowa geologiczna pola Górsko w kopalni Wieliczka” [The Geological Structure of the ‘Górsko’ field in the Wieliczka Mine]. Academic supervisor: prof. dr hab. Aleksander Garlicki

1994 **Master Degree in Environmental Protection**

Master studies (1989-1994):

AGH University of Science and Technology in Cracow, Faculty of Geology, Geophysics and Environmental Protection, speciality: Protection of the Natural Environment and Mineral Resources

Master thesis in Polish: “Występowanie metali w wodzie i w osadach dennych w Zbiorniku Goczałkowice” [The Occurence of Metals in the Waters and Bottom Sediment of the ‘Goczałkowice’ Reservoir]. Academic supervisor: prof. dr hab. inż. Jacek Motyka

2003 **PhD in Environmental Engineering**

Cracow University of Technology, Faculty of Environmental Engineering. PhD thesis in Polish: “Hodowla synchroniczna *Chlorella vulgaris* w kontroli jakości wód” [The Use of Synchronous Culture of *Chlorella vulgaris* in Water Quality Control]. Academic supervisor: dr hab. inż. Beata Cwalina; reviewers: prof. dr hab. Władysław Wardas, prof. dr hab. Renata Kocwa-Haluch.

# 3 Information concerning employment in research institutions up to this day

1995-1996: I worked (for 8 months) in the Division of Environmental Protection at the Institute of Oil Extraction and Gas Industry in Cracow.

1996-present: 01.10.1996-30.04.2005 an assistant at the Division of the Foundations and Systems of Environmental Protection of the Cracow University of Technology; from 01.05.2005 adjunct professor at the Division of the Foundations and System of Environmental Protection; thereafter at the Department of Water Supply, Sewerage and Environmental Monitoring of the Cracow University of Technology.

# 4 Accomplishments in accordance with art. 16 point 2 of the Academic Degrees and Academic Title as well as Degrees and Title in the Academic Field of Art Law from 14.03 2003 (Dz.U. nr 65. poz. 595 ze zm.)

## 4.1 The title of the academic accomplishment

*The Determination of the Distribution of Concentration Values of Chosen Water Quality Indicators in a Shallow and Polymicitic Reservoir Based on the Example of the 'Goczałkowice' Reservoir.*

The basis for the application for the habilitation degree consists of a series of seven publications devoted to the scrutiny and research of the notion of the distribution of chosen water-environment pollutants in the shallow and polymictic water dam reservoir on the example of the 'Goczałkowice' Reservoir. In the process of my long-lasting studies of the water environment I have also published many papers, put together in pint 6.1 of this summary.

## 4.2 The author, publication title, publication year, publisher

**Czaplicka**-Kotas A., Zagajska J., Ślusarczyk Z., Szostak A., 2010, *Metale ciężkie w wodach dopływających do Zbiornika Goczałkowice w latach 2000-2007*, Gospodarka wodna 12/2010, s. 499-502.

**Czaplicka**-Kotas A., Ślusarczyk Z., Zagajska J., Szostak A., 2010, *Analiza zmian zawartości jonów wybranych metali ciężkich w wodzie Jeziora Goczałkowickiego w latach 1994-2007*, Ochrona Środowiska 4/2010 Vol. 32, s. 51-56.

**Czaplicka**-Kotas A., Ślusarczyk Z., Pięta M., Szostak A., 2012, *Biogeny w wodach dopływających do Zbiornika Goczałkowice*, Gospodarka wodna 10/2012, s. 428-434.

**Czaplicka**-Kotas A., Ślusarczyk Z., Pięta M., Szostak A., 2012, *Analiza zależności między wskaźnikami jakości wody w Jeziorze Goczałkowickim w aspekcie zakwitów fitoplanktonu*, Ochrona Środowiska 1/2012, Vol. 34, s. 21-27.

**Czaplicka** A., Ślusarczyk Z., Szarek-Gwiazda E., Bazan S., 2017, *Rozkład przestrzenny żelaza i manganu w osadach dennych Zbiornika Goczałkowice*, Ochrona Środowiska 3/2017, Vol. 39, s. 47-54.

**Czaplicka** A., Bazan S., Szarek-Gwiazda E., Ślusarczyk Z., 2016, *Spatial distribution of manganese and iron in sediments of the Czorsztyn Reservoir*, Environment Protection Engineering Vol. 42 No. 4/2016, s. 179-188, ISSN 0324-8828.

**Czaplicka** A., Szarek-Gwiazda E., Ślusarczyk Z., 2017, *Factors influencing the accumulation of Pb in sediments of deep and shallow dam reservoirs*, Oceanological and Hydrobiological Studies Vol. 46, Issue 2, June 2017, s.174-185.

## 4.3 An analysis of the aforementioned works' academic goals and of the results achieved and their possible application

### 4.3.1 Introduction

There are many factors that make the reservoirs different from each other, for example: morphometric features, age, water residence time, trophic state, size of the catchment basin and anthropogenic land use,

The 'Goczałkowice' Reservoir is a shallow reservoir, thus vulnerable to waves. It is a polymictic reservoir where thermal stratification occurs only in winter when the water surface is frozen and waters are completely mixed in the other seasons [1].

Not much was researched on the influence of water mixing (in polymictic/dimictic reservoirs) on the spatial distribution of metals in the bottom sediment thus far. This is especially important for the assessment of ecological risk in dam reservoirs, such as the 'Goczałkowice' Reservoir that are used for the storage of potable water. The placement of the old riverbed may influence the spatial distribution of metals in the bottom sediment as well. However, the earlier research in this matter is ambiguous [2, 3, 4, 5]. In recent years, among the often discussed topics were: the accumulation of metals in the sediment of dam reservoirs and the factor influencing that process has often been discussed [5, 6, 7, 8, 9], the mobility and bioavailability of metals [7, 10, 11], and the analysis of sedimental cores [12, 13].

### 4.3.2 Analysis of the academic aim

The main academic aim that I present is to analyse the influence of water-mixing in a polymictic reservoir on the example of the 'Goczałkowice' Reservoir on the distribution of chosen water quality indicators. In case of the water I have analysed the spatial variablitiy of subsoil water in the reservoir's area. I have also checked whether considerable discrepancies can be traced in the values of water quality indicators in a vertical profile between subsoil water samples and samples taken from deeper parts of the reservoir, that is 2 metres or 6 metres deep. When it comes to the sediments the aim of my work was to identify the factors influencing the accumulation of chosen metals in the deep and dimictic 'Czorsztyn' Reservoir. Among the factors influencing the accumulation of metals, in my work I have analysed the following: varying depth and topography of the bed, content of the organic matter, placement of the old riverbed, and the granulometric sediment fractions.

### 4.3.3 Analysis of the results

My thesis is a result of many years of research concerning chosen quality-indicators of water environment in the 'Goczałkowice' Reservoir. The said reservoir is a source of water and fish for the inhabitants of the Upper Silesia region. It is also a natural habitat for waterfowl that falls under protection of the 'Obszar Natura 2000' programme. That is why the pollution of this region is a matter of highest concern for biological and economic reasons. The main aim of this thesis is to analyse the distribution of the concentration of chosen water quality indicators in the shallow and polymictic 'Goczałkowice' Reservoir. The average depth of the reservoir is 5,3 metres. However, the major area of the reservoir is no more than 2 metres deep. It is commonly agreed that the water in the reservoir mixes as a result of undulation and wind, and vertical stratification is only to be seen in winter, when the surface layer of water is frozen. That does not, however, occur very often [1]. Some of the ascertainments mentioned above were verified in the thesis itself.

An overview of my own work concerning this topic has been conducted. First, the sources of environmental pollution of water in the reservoir had been analysed. Then, an analysis of my own works had followed, with focus on works concerning spatial variability of the concentration of chosen water quality indicators and the fluctuation of said indicators in a vertical profile of the reservoir. Finally, the spatial distribution of chosen metals in the bottom sediment of a shallow and polymictic reservoir on the

example of the ‘Goczałkowice’ Reservoir in comparison to a deep and dimictic reservoir on the example of the ‘Czorsztyn’ Reservoir.

While analysing the water environment quality indicators in the ‘Goczałkowice’ Reservoir, the source of its pollution has been recognized. The catchment basin of the reservoir has an area of around 520 $km^2$. Among the potential anthropogenic pollutants of the water environment one can indicate: chemical fertilizers and plant-protection chemicals that reach the waters as a result of a run-off; industrial, household, and domestic waste water that had been only partially purified; precipitation of dust coming from the burning of fossil fuels in nearby regions; or water drainage from nearby fish ponds. As natural sources of pollution, the weathering of rocks, and the presence of silty soil, marshlands [14], and artesian as well as subartesian waters in the catchment basin [15] can be indicated. It is estimated that the waters of the reservoir come from the following sources: the River ‘Vistula’ – 82%, the River ‘Bajerka’– 4%, five pumping stations account for 10% (four of them are dehydrating the area situated in the depression and are situated in the south-western part of the reservoir, whereas the pumping station in ‘Strumień’ is situated on the western side), finally, 4% comes from rainfall [16]. The concentration of iron, manganese, copper, zinc, and lead has been analysed [17], together with the concentration value of total phosphorus, ortophosphorus, nitrogenium in the form of ammoniacal nitrogen, nitric nitrogen, and nitrite nitrogen [18] in the water flowing into the reservoir in an multiannual period has been analysed as well. In the case of metals it has been stated that the concentration values of lead and zink in the water exceed the values accepted as the geochemical background. The concentration values of iron and manganese are difficult to determine because of the fact that surface waters contact and mix with groundwaters and peatbog. The concentration of copper did not exceed the geochemical background. The concentration of nutrients in the water does not exceed the value of anthropogenic pollution. The biggest loads of pollutants are brought into the reservoir by the river ‘Vistula’, yet a considerable amount of pollutants (metals 19-38%, nutrients 13-47%) are brought in by the waters of local tributary rivers. The concentration values brought in by the ‘Vistula’ river and being a product of anthropopressure are of a different type than those being brought in by the tributary rivers. While researching local tributary rivers for seasonal changes in concentration values, the values observed in winter were considerably different (except for lead) than in the remaining seasons. The concentration values of

ammoniacal nitrogen and nitric nitrogen in the inflowing waters are dependant from the season. The biggest loads of nutrients are carried in during winter and spring. The eutrophic state of the water in the reservoir is a sign indicating lack of sufficient protection of the reservoir's waters from the inflow of nutrients.

Concentration values of iron, manganese, lead, zink and copper in the 'Goczałkowice' Reservoir have been analysed in a span of multiple years [19]. The choice of iron and manganese is justified by the research conducted in the waters of the reservoir [20, 21] that indicated a high annual fluctuation of of said metals. Copper has been chosen because copper sulfate had been used to manage the blooming of cyanoses (*Cyanobacterium)* in the reservoir [22]. Unpublished data and research results from the Division of Water Biology at the Polish Academy of Science in Cracow from the years 1987-1990 point at raised concentration values of zinc and lead in the waters of the 'Goczałkowice' Reservoir and in the fish tissue of the fish found in it [23]. The waters in the reservoir are polluted with heavy metals exceeding severely the values of the geochemical background in the case of lead and zink, and periodically in case of copper. While analysing the fluctuations of the average annual metal concentration rates in the researching period, one can observe that in case of average concentration of iron and manganese a growing tendency could be observed in the years 1994-2007. Furthermore, during that period seasonal changes of manganese concentration have been observed – lowest in winter, and highest in summer. Those changes can be connected with the fluctuations of oxygen-concentration in the water (negative correlation), which can be assigned to the high mobility of manganese and its migration between the sediments and water. In the waters of the 'Goczałkowice' Reservoir an average correlation between the concentration of iron and manganese has been proven. The analysis shows as well that in the years 1994-2007 it is impossible to assign any statistically enticing trends to the annual concentration values of copper, lead and zink. In the case of copper, a periodical increase of concentration values has been observed in the beginning of the 90s as at that time, the reservoir had been covered with a copper-based layer.

The present-day literature on this topic indicates that the pollutants inside of the reservoir are well mixed in the entire body of water as the reservoir is shallow. Data concerning chosen water-quality indicators from the years 1994-2009 were analysed. To that end, water samples were taken from the surface waters in 8 sampling points

throughout the area of the reservoir, as well as from the depth of 6 m in three sampling points, and 2m in one sampling point in a deeper part of the reservoir. The number of measurements taken for every water-quality indicator reaches 112 (in the case of chlorophyll a) and 249 ( nitrogen compounds). It was proven that because of the depth at which the water sample was taken (in case of the samples collected in the same timespan) the biogenic inicators, as well as the concentration values of iron and manganese vary strongly between the samples collected from sampling points situated near the surface water (‘P’ sampling points) and those collected from sampling points situated 2m and 6 m deep (‘G’ sampling points). The analysis of the homogeneity of sampling points in group ‘P’ for all of the water-quality indicators did not show any noticeable spatial differences among the average values that could be caused by the positioning of the sampling points within the reservoir. However, iron is an exception, the concentration of which may be divided into three separate and distinct groups: a group of sampling points situated in the northern and eastern area of the reservoir (five sampling points with the lowest average values of iron concentration), sampling points situated near the ‘Zarzecze’ pumping station and the mouth of the ‘Bajerka’ River, and one sampling point situated in the backflow of the ‘Vistula’ river, with the highest average value of iron concentration. By the analysis of the homogeneity of sampling points in case of the ‘G’ group, narrowed down to the values collected in the same month for every sampling point, substantial differences have occurred only in case of oxygen indicators. As a result it has been stated that there are no grounds to contest the hypothesis that a sampling point situated by the water abstraction points can be representative for all of the sampling points of the ‘G’ group. (except for the oxygen indicators).

Thus, a statistical analysis of the results indicates that the thesis that all the waters inside of the reservoir are well-mixed could be taken into account only to a certain, narrow extent, which concerns the sampling points from the ‘P’ group. All of the average values of water-quality indicators from the surface water (except for iron) did not vary, no matter the area from which the sample had been gathered. The observed fluctuance of average concentration values of iron in the ‘P’ sampling points seems to be of considerable importance because of the vicinity of pollution sources, such as the ‘Vistula’ river with its dominating flow, the small, local tributary rivers bearing a high concentration of iron coming from the ‘Zarzecze’ and ‘Frelichów’ pumping stations (resulting from the influence of artesian waters that are rich in iron

and, partially, a peatbog nature reserve) or the ‘Bajerka’ river together with reject waters from the peatbog nature reserve. The remaining sampling points constitute the third group, with lowest iron concentration values. Yet, the results of the research concerning groups ‘P’ and ‘G’ do not conform with the thesis presented by experts that the waters of the ‘Goczałkowice’ reservoir are well-mixed throughout the entire area of the reservoir; namely, the average values of water-quality indicators vary signicifantly depending from whether the samples were collected from the surface water or from deeper parts of the reservoir. Certain mechanisms are known that can influence the fluctuances in the water quality that is being observed in surface and shallow water. Many factors may influence the concentration of a given indicator such as the varying speed of waterflow at different depths of the reservoir, as well as its contact with bottom sediments or the lack of it. A similarly strong chemical differentiation of waters in ‘P’ and ‘G’ groups of sampling points has been observed in the time of phytoplankton’s growth. One of the reservoir’s characteristics is the fact that most of the analysed values of the indicators (except for ammoniacal nitrogen and nitrite nitrogen) have shown a substantial seasonal variability throughout different seasons [24].

Factors indicating different factors that influence the spatial distribution of manganese, iron, and lead in the bottom sediments of a shallow and polymictic ‘Goczałkowice’ Reservoir have also been analysed in comparison with the deep and dimictic ‘Czorsztyn’ Reservoir. As far as the latter is concerned, its catchment is covered with forests and farmlands. There is almost no industry in this region and the density of population is very low. The exception are illegal tanneries that pollute the water environment of the ‘Dunajec’ river, predominantly with chrome particles [25, 26].The potential sources of anthropogenic pollution concern municipal wastewater from two cities (with population reaching 90000 and around 30000 tourists annualy) and villages situated in the area of the catchment, surface runoffs from the farmlands, and illegal landfills.

It is commonly known that heavy metals are an integral element of water environment and thus, of bottom sediments as well. They get into the water as a result of natural processes as well as anthropogenic activity. The main factors influencing the content of the bottom sediment are: the geological structure of the catchment, climatic conditions and human activity. Heavy metals are toxic and non-

biodegradable substances. Iron and manganese are considered necessary for human organisms to function correctly, however, their superabundance is harmful [27]. The fact that they are present in the water environment in the form of oxides and hydroxides is supporting their ability to absorb other metals [28]. When it comes to lead, it is one of the most toxic heavy metals, situated on the 6th place out of ten on the list of the 10 mist environmentally harmful toxins composed by the Commision of Environmental Toxicology by the Polish Academy of Sciences.

In order to analyse the concentration of manganese, iron and lead in the bottom sediments of the dam reservoirs, samples of the bottom sediment in every reservoir have been collected from 26 sampling points situated along the right bank, the main axis and the left bank of the reservoir. The research did also concern the granulometry of the sediments and their content of organic matter.

It has been observed that the spatial distributions of the scrutinised metals inside of the ‘Goczałkowice’ Reservoir are not fully correspondent. The Spearman’s rank correlation coefficient between the content of iron and manganese in the bottom sediment was rs=0.75. A reason for those observations may lie in the fact that the deep and shallow areas of the reservoir have a different water temperature in the bottom, which influences the aerobic conditions and thus, the changes in manganese concentration in the benthic waters and bottom sediments [29]. Other correlations have been observed in case of the ‘Czorsztyn’ Reservoir, which is a much deeper reservoir, with a fairly equalized water temperature near the bottom, resulting in similar aerobic conditions and and a lower fluctuance of manganese-concentration (the correlation coefficient between the concentration of iron and manganese in this reservoir was rs=0.94) [30]. The iron-concentration levels in the bottom sediment has shown a very high correlation with the concentration levels of such trace metals as cadmium, copper, nickel, lead or zink, which can point at their common or similar geochemical or anthropogenic origin and a similar feature of being prone to be bound by small fractions of sediments and organic compounds. The mobility of manganese compounds may be the reason for lower values of the correlation coefficient of manganese concentration with other metals (Cd, Cu, Ni, Pb, Zn). This is different from the case of the shallow and polymictic ‘Goczałkowice’ Reservoir analysed in this thesis.

Among the factors influencing the concentration levels of lead and iron in the bottom sediment of both of the reservoirs one can name: the content of the clay and silty clay fractions, together with the content of organic substance in the sediment, the depth of the reservoir or the placement of the old riverbed within the reservoir. The layout of the bottom sediments was more regular in the deep 'Czorsztyn' Reservoir and less regular in the shallow 'Goczałkowice' Reservoir (Fig. 1). In the former, the granulometry of the sediment was typical for deep reservoir – the sand fraction was lowering and the clay fraction was raising going from the upper part of the reservoir to the lower (the one close to the dam). The higher content of the sand fraction along the left bank is due to the fact that 6 small tributary rivers that bring in and amass the sand in the vicinity of their estuaries inside of the reservoir. A less regular topography of the shallow 'Goczałkowice' Reservoir makes it easier for the clay and silty clay fractions, as well as organic matter to accumulate in deeper parts of the reservoir in the middle and left-bank side of it. The sand fraction was the dominant one mostly in the area close to the bank (also close to the dam), which can be connected with the types of soil present in the direct catchment, as well as with the sediment mobilisation of the more shallow area and their accumulation in deeper areas of the reservoir. A similar phenomenon had previously been observed in other reservoirs [31]. A less regular, mosaic-like placement of different sediment fractions and organic matter may also be attributed to the fact that its waters are prone to undulation and thus, to sediment mobilisation and saltation, resulting in the movement of sediments to different parts of the reservoir. This phenomenon was also observed in the polymictic 'Włocławek' Reservoir as well [32]. The research data indicates that a slightly different bottom topography of deep and shallow reservoirs does favour a differing spatial distribution of clay and silty clay fractions, as well as organic matter, which all have a potential ability to bind metal (Fig. 2). In shallow reservoirs it is often difficult to systematise similar groups of comparable grain size because of an uneven distribution of granulometric fractions. In my opinion, the implementation of a hierarchical cluster analysis of concentration levels in the scope of sediment granulometry allowed for an identification of sediment sampling points with similar sediment grain cohesion. A high correlation between tiny fractions and metals indicates a similar spatial distribution of metal concentration levels in bottom sediments of reservoirs and indeed in the identified groups of sampling points the average concentration levels of lead did vary considerably (Fig. 1 i 3) [33]. Thus, the

distribution of tiny fractions, as well as of organic substances in both of the reservoirs determine the special distribution of lead. In the ‘Czorsztyn’ Reservoir it is regular and raises towards the dam, whereas in the ‘Goczałkowice’ Reservoir it is irregular, and the lead accumulates in the deeper parts situated in the middle part of the left bank area of the reservoir or in the shallow sampling points along the right bank, which is rich in silty clay and clay fractions and organic substance. Irregular distribution of lead concentration has also been identified in the shallow ‘Kaunas’ Reservoir in Lithuania [4]. The accumulation of lead was affected predominantly by the clay fraction in the ‘Goczałkowice’ Reservoir, and the silty clay fraction in the ‘Czorsztyn’ Reservoir. The distribution of metals in both of the reservoirs is also affected by the localization of old riverbeds, wherein a higher level of lead-concentration was found in the bottom sediment of the shallow and highly polluted old riverbed of the ‘Vistula’ River in the area of the ‘Goczałkowice’ Reservoir. A higher content of silty clay and clay fractions in the right side of the ‘Czorsztyn’ Reservoir was caused by the old riverbed of the ‘Dunajec’ River, as well as by the outcrop of carbonate rock in that area [34]. Data coming from previous research on the spatial distribution of metals in bottom sediments indicate a lack of fluctuance, however, they also indicate a raise or decline of metal concentration levels in the vicinity of old riverbeds in the area of the reservoirs [2, 3, 4, 5]. It is important to keep in mind that there are many other factors that can influence the accumulation of metals in the bottom sediments of dam reservoirs, such as: water circulation, the influence of small, local tributary rivers, sources of the pollution of the direct catchment, as well as undulation that causes sediment mobility..

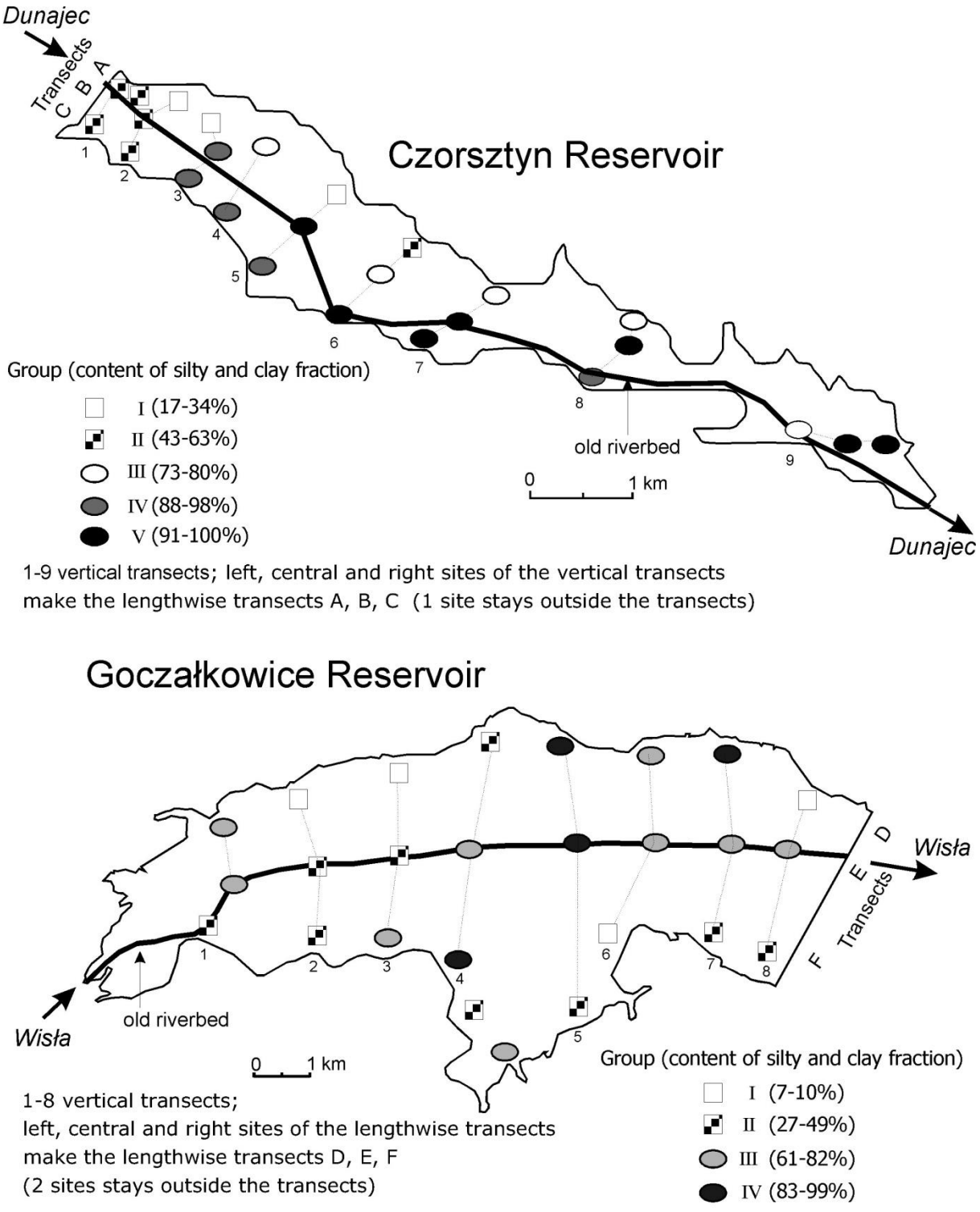


Fig. 1. Location of the sampling sites. Identification of groups (clusters) of similar sediments granulations.

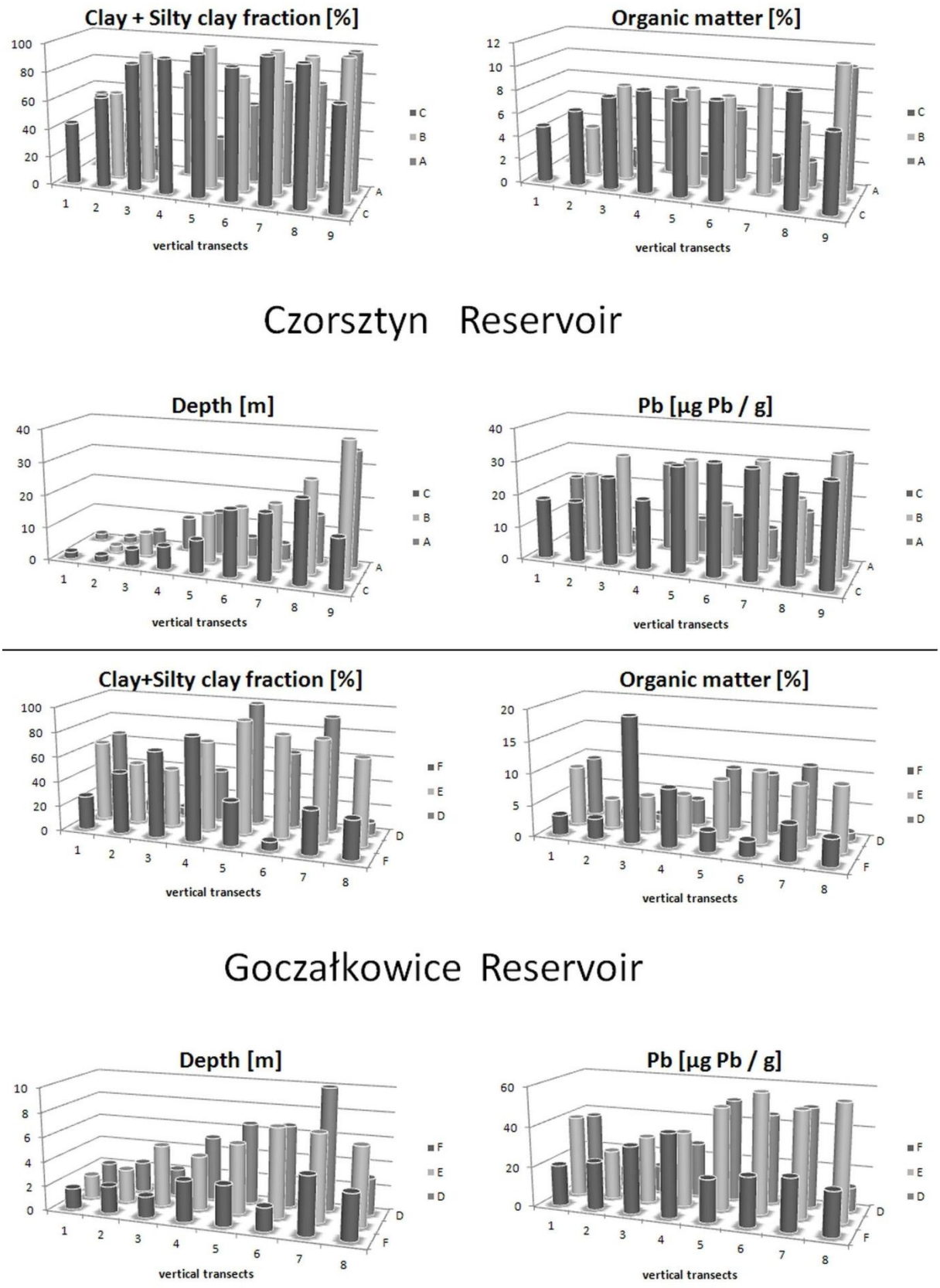


Fig. 2. Distribution of selected parameters in Czorsztyn and Goczałkowice Reservoirs.

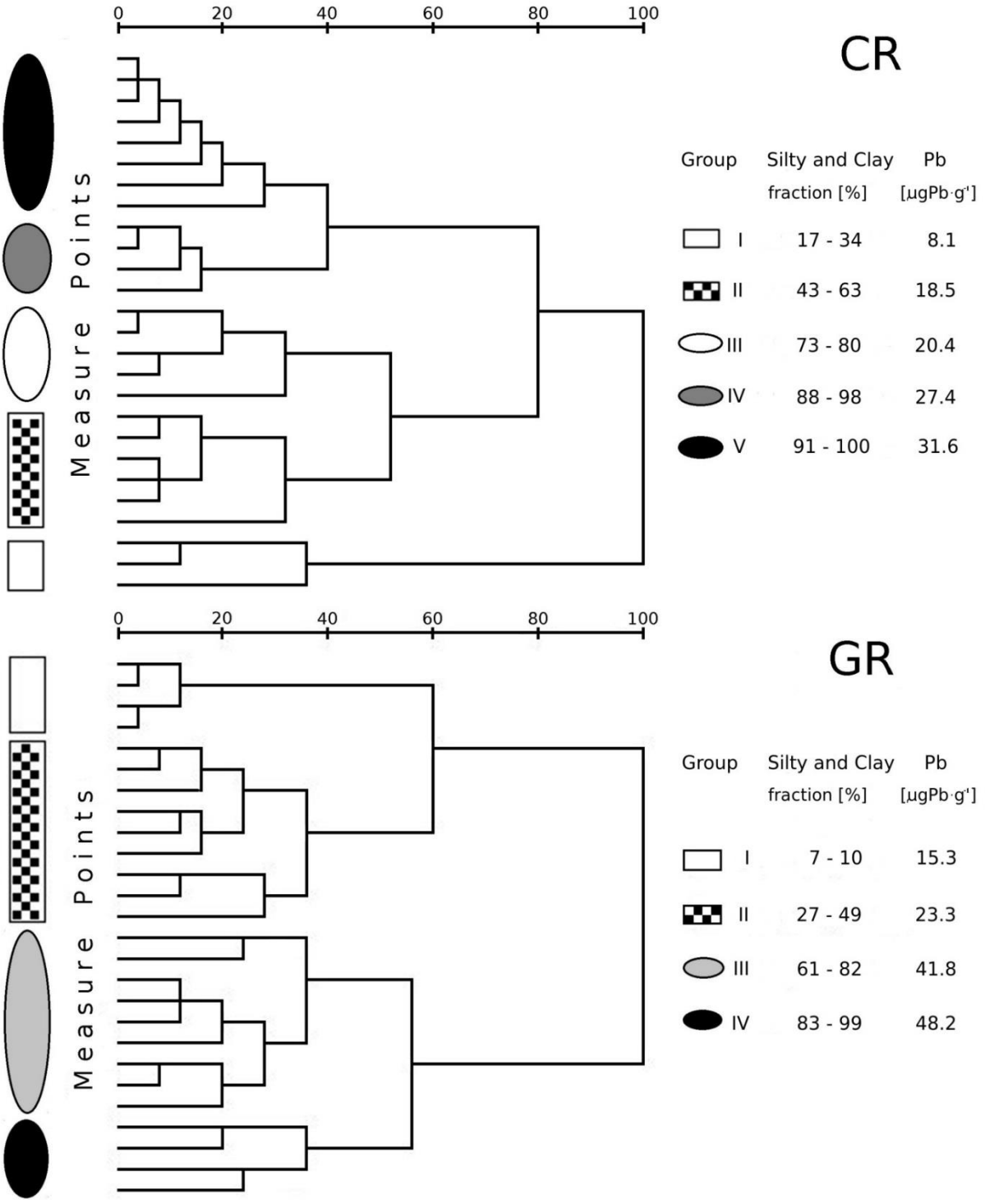


Fig. 3. Hierarchic cluster analysis based on sediment granulation in the Czorsztyn (CR) and Goczałkowice (GR) Reservoirs. Contents of clay and silty clay fractions (range) as well as Pb (mean) in different clusters are given.

**Literature:**

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### 4.3.4 Possible application of the results

The research done by me and my research group concern i.a. the designing of monitoring systems, performance of research and assessment of the quality of water environment that can be used in environmental management.

Thus, having designed a research of the nutrients indicating at their high concentration values, as is the case with the catchment basin of the 'Goczałkowice' Reservoir, one can formulate a series of methods aimed at eliminating those contaminations. In case of the 'Goczałkowice' Reservoir I suggest: modernizing the water purification system in the catchment basin of Vistula river by introducing the 3rd level of water purification by means of the extraction of nitrogen and phosphorus compounds; building a sewage works on the southwestern side of the reservoir (so that domestic waste water and reject water from farmlands would not contaminate the potable water reservoir); running pipes throughout the catchment basin area; purifying the waters drained from fish-breeding ponds, and planting a solid belt of deciduous plants around the reservoir and the river Vistula, which would make for a buffering area, intercepting fertilizers and plant-protection substances from the farmlands. The 'Goczałkowice' Reservoir, other dam reservoirs alike, is susceptible to eutrophication, so it is of crucial importance to explain the processes taking place inside of it. It is important to emphasize that in case of such a high nutrient content in the water environment, appropriate climate conditions are enough for a cyanosis-dominance to develop. Some of the cyanoses produce highly toxic substances (hepatotoxins, cytotoxins, neurotoxins, dermatoxins) to which the consumers of water are highly vulnerable. Thus, it is necessary to limit the inflow of nutrients to the reservoir's waters. The dominance of cyanoses in this particular reservoir is especially dangerous as it is the source of potable water for the entire region of Górnośląskie Zagłębie Węglowe. Fish from the reservoir are being caught for consumption, the area is under protection of the 'Obszar Natura 2000" program so it is vital to care for the quality of its waters.

In the case of metals, exploring the correlation between different metals may account for a common source of contamination or the lack of it. This research indicates at the possibility of certain metals to migrate between water and the sediment. Furthermore, based on the geological structure of the catchment basin and the knowledge of contamination sources it is possible to indicate with what substances (granulometric fractions, organic substance) do the metals found in the

bottom sediment bind. The research does also point at the possibility of estimating where the places with the highest concentration of metals in bottom sediment can be found, based on the knowledge of the bathymetry of the reservoir and its water-mixing capability.

Moreover, my research will help understand the processes taking place in the shallow and polymictic water reservoirs in comparison with the deep and dimictic ones. It can also be used in the future to help with comparatist research of different reservoirs.

# 5 An analysis of the remaining academic accomplishments

## 5.1 Before acquiring the Ph.D. title

I have started my academic activity concerning environmental protection and engineering after graduation, while working in the Division of Environmental Protection at the Institute of Oil Extraction and Gas Industry in Cracow (1.09.1995 to 30.04.1996). While working at the Institute I took part in the realization of the following tasks:

- Assessment of a investment's impact on the environment (underground gas storage in the 'Siedlec-Moszczenica mine);
- A complex Environmental Impact Assessment of the Cavern Unerground Gas Storage 'Mogilno' (this work has received a very positive opinion from the National Main Sanitary Inspectorate as well as from the Minister of Environmental Protection and the Protection of Natural Resources and Forestry);
- Environmental Impact Assessment of seismic and drilling works filed in in the process of granting a license for the search and excavation of ores in certain areas;
- Environmental Impact Assessment of oil and gas excavation.

From 1996 to 1997 I conducted a research, supervised by professor Renata Kocwa-Haluch, concerning the possible application of microorganisms in the process of decontamination of sewage and technological systems [1, 2, 3].

In the years 1997-2000 I took part in a research conducted by prof. Tadeusz Wilczok at the Chair for Biochemistry and Biophysics of the Silesian Medical Academy (Silesian Medical University) concerning the possible application of a

synchronous culture of *Chlorella vulgaris*-based bioassays to the control of surface-water quality and to assess the toxicity of water and tannery waste [4]. I also took part in the designing of this research. This research was partially connected with my PhD thesis and partially with other projects presented by our research group on many conferences. It is commonly known that applying bioassays in the process of the assessment of aquatic environment's toxicity is a valuable addition to other physicochemical and biological research. Currently over a hundred of short-term bioassays are being used. One of them is the synchronous culture of *Chlorella vulgaris* seaweed, which has been used by our research group to assess the level of toxicity of water and tannery waste.

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## 5.2 After the Ph.D. title

I have continued to apply and extend my interests and academic work predominantly when it comes to researching and assessing the quality of the aquatic environment, with water dam reservoirs in focus. I have collaborated with scientists working in the following institutions:

- Medical University of Silesia, Faculty of Pharmaceutic Science and Medical Analysis in Sosnowiec

- Institute F.A. Forel at the University of Gene • AGH University of Science and Technology
- Waterworks of Upper Silesia, at the Water Purification Station in Goczałkowice
- Institute for the Protection of Nature at the Polish Academy of Science
- Regional Station for Sanitary Service and Epidemiology in Cracow.

Multiple publications have been published as a result of these collaborations. For many years, I have been analysing the quality of water environment in the 'Goczałkowice' Reservoir. To that end I have used physical, chemical, and biological research. My Ph.D. thesis and a monographic publication written on the base of the said thesis concerned the possible application of *Chlorella vulgaris* seaweed in synchronous culture (in which all of the cells are on the same stage of growth) to the mechanisms of control of the water environment. For these works I have received the Academic Award of the Rector of the Polish University of Technology. In my opinion, an important conclusion that I have reached in the process of my research is indicating the best indicators of changes in the water environment, from a total of 9 indicators extracted from the Chlorella vulgaris seaweed, that being chlorophyll a, chlorophyll b, neoxanthin and zeaxanthin [2]. What is more, together with a research group from the Medical University of Silesia I have published a series of research data on the assessment of the quality of water environment in the 'Goczałkowice' Reservoir using the synchronous culture of Chlorella vulgaris [3,4], on the chemical structure of the compounds found in tannery waste [5] tested with the aforementioned bioassay, an analysis of possible application of the said bioassay as a cheap and time-efficient method of water-quality control, followed by a suggestion of criteria that can be useful in that process [6,7].

Moreover, together with a research group from the Cracow University of Technology and/or from the Waterworks of Upper Silesia I have analysed:

- the influence of flood in the year 1997 and 2010 on the quality of water in the 'Goczałkowice' Reservoir [8, 9];
- nutrients contained in the waters flowing into the reservoir [10, 11], I have estimated, using different methods, the change of the trophic state of waters in the 'Goczałkowice' Reservoir in a multiannual span [12], and the risks of water-eutrophication in the said reservoir [13];

- chosen metals in the aquatic environment of tributary rivers of the 'Goczałkowice' Reservoir [14], as well as metals contained in the waters of the reservoir itself [15-19].

At the same time, from June 2004 I have collaborated with a research group led by prof. Janusz Dominik from Institute F.A. Forel at the University of Geneve in a project concerning research on waters, bottom sediments, and chrome accumulation in organisms inside the basins of the 'Dunajec', and 'Białka' River, as well as in the 'Czorsztyn' Reservoir.

I have also conducted research on the content of chrome in the bottom sediment in the basin of the 'Dunajec', and 'Białka' rivers, and the 'Czorsztyn' Reservoir in frame of an academic grant supervised by dr hab. inż. Ewa Szalińska, at the AGH University of Science and Technology. There are a lot of illegal tanneries in the basin of 'Dunajec' River, and thus in the 'Czorsztyn' Reservoir itself. We have shown that those tanneries do contaminate the water environment with chrome [20]. The bottom sediment of the 'Czorsztyn' Reservoir is prone to accumulate chrome particles. Based on the samples collected from a regular net of sampling points situated within the reservoir, we have analysed the spatial distribution of the concentration of chrome particles and we created a map of chrome pollution in the bottom sediment of the reservoir [21]. In the literature on this topic it is indicated that chironomidae can be useful in the monitoring for the water environment which is rich in metals [22]. We have analysed the accessibility of chrome for the chironomidae and factors that can potentially influence the bioaccessibility of chrome for those organisms in laboratory and field tests [23-26]. We have also analysed the concentration levels of zink in the bottom sediment of the reservoir [27].

From 2010 I am collaborating with dr hab. Ewa Szarek-Gwiazda, professor working at the Institute for the Protection of Nature at the Polish Academy of Science. Together, we are researching the concentration of metals in the bottom sediments of 'Goczałkowice', 'Czorsztyn', and 'Dobczyce' reservoirs [28, 29]. We are describing the spatial distribution of metals connected with the geochemical background or the anthropogenic pollutions in connection with, among other, the granulometry of sediments, concentration of organic substance, depth of the reservoir, old riverbeds

within the reservoirs. Our method of analysing the data is i.e. the hierarchical analysis of concentration, which we have described in a separate paper [30].

I collaborated with mgr Katarzyna Pokrzywa from the Regional Station for Sanitary Service and Epidemiology in Cracow, analysing the quality of the water in the ‘ Bagry’ Reservoir in terms of recreational use. We have also researched the Reservoir’s history [31].

We have implemented the method of SEM to the process of monitoring for the water environment, with bottom sediments, and microorganisms in our main focus [32, 33, 34].

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### 5.3 Academic and research work on different topics

From 2015 I have also started my academic research concerning light pollution. I am a member of a research group of the 'Workshop for the Monitoring of Light Pollution' led by dr hab. Tomasz Ścieżor at the Faculty of Environmental Engineering at the Cracow University of Technology. At the present, I have recognized the problem of light pollution in scope of the danger it poses for living organisms. [1, 2]. I have also recognized the problem of light emitted by architectural objects [1, 3-5].

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# 6 A summary of accomplishments and output

## 6.1 Academic and research activity

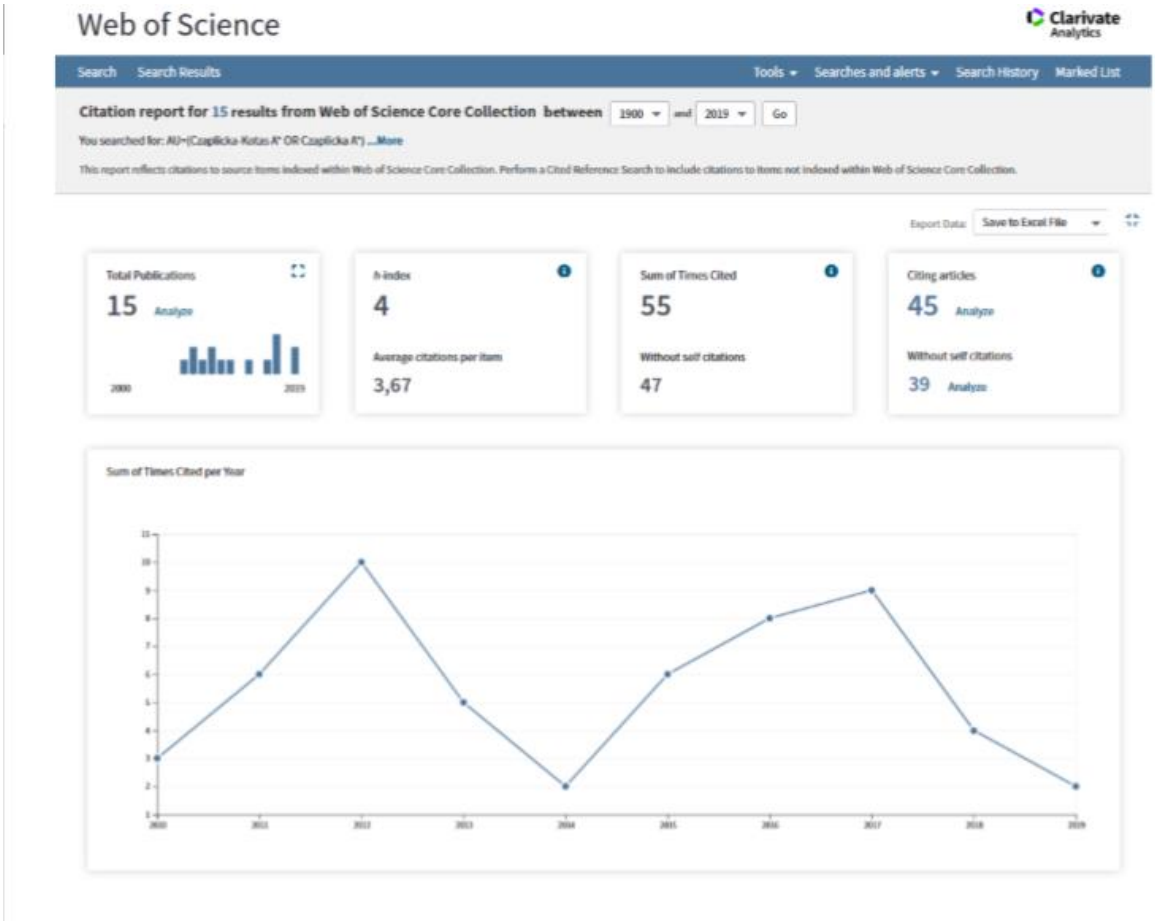
| Rodzaj osiągnięcia | Przed doktoratem | Po doktoracie | RAZEM |
|---|---|---|---|
| Monographs in Polish (including the only or main author) | 0 | 1 (1) * | 1 (1) * |
| Articles in journals listed in JCR (including the only or main author) | 0 | 15 (8) | 15 (8) |
| Articles in journals other than listed in JCR (list B) (including the only or main author) | 3(1) | 28 (14) | 31 (15) |
| Chapters in monographs (including the only or main author) | 1(0) | 2 (2) | 3 (2) |
| Papers in proceedings of conferences (including the only or main author) | 9 (7) | 16 (7) | 25 (14) |
| Organization of conferences | 0 | 3 * | 3 * |
| Presentations at conferences | 10 | 18 | 28 |
| Participation in domestic research projects ** | 0 | 1 | 1 |
| Managing of research project | 0 | 0 | 0 |
| Reviewing of articles and conference papers | 0 | 2 | 2 |
| Awards for scientific activity | 0 | 2 | 2 |
| **Total IF** according to Web of Science (according to publication year) | | 16,124 | 16,124 |
| Number of citations according to Web of Science (excluding self-citations) *(as on 16.04.2019)* | 0 | 55 (47) | 55 (47) |
| Hirsch index according to Web of Science | 0 | 4 | 4 |
| Hirsch index according to Google Scholar | 0 | 7 | 7 |
| Number of citations according to Scopus (excluding self-citations) *(as on 10.01.2018)* | 0 | 59 (51) | 59 (51) |
| Number of citations according to Google Scholar *(as on 10.01.2018)* | 0 | 153 | 153 |
| Sum of MNiSW points, according to publication year (*including those devoted entirely or partly to* | 0 | 424 (375) | 424 (375) |

| | | | |
|---|---|---|---|
| *the described problem*)*** | | | |
| Participation in research carried out as part of statutory activities | 1 | 10 | 11 |

*) including those devoted entirely or partly to the described problem

**) excluding “statutory activities” (DS) and “own research” (BW)

***) including the percentage share in the total publication




**A summary of publications devoted entirely or partially to the research area of assessment and scrutiny of water environment:**

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**Czaplicka**-Kotas A., Szalińska E., Wachałowicz M., 2008, *Rozkład stężeń chromu w osadach dennych zbiornika Czorsztyńskiego*, Gospodarka wodna 11/2008, s. 451-462, ISSN 0017-2448.

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**MNiSW** (2011): **4** pkt.

**Czaplicka**-Kotas A., Ślusarczyk Z., Pięta M., Szostak A., 2012, *Analiza zależności między wskaźnikami jakości wody w Jeziorze Goczałkowickim w aspekcie zakwitów fitoplanktonu*, Ochrona Środowiska 1/2012, Vol. 34, s. 21-27, ISSN 1230-6169.

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## 6.2 Didactic and popularizing activity

### 6.2.1 Didactic activity

My didactic activity is connected above all with environmental protection, but also with environmental engineering. Currently, I am the head of subjects: Monitoring and management for the environment, Global environmental changes, Basics of sozology and sozotechnic, Anthropogenic environmental pollution. I have prepared programs for the following classes currently being conducted: 15 hours of lectures in the field of monitoring for environment and 15 hours of exercises in the field of monitoring and environmental management as part of the subject Monitoring and environmental management, 15 hours of lectures on Global environmental changes, 15 hours of lectures and 15 hours of exercises from the basics of sozology and sozotechnic. I also run classes in the basics of engineering and environmental protection, social conflicts in the investment process and negotiations in the investment process. In addition, I am currently partially conducting lectures in the field of law - Law in environmental engineering (5 hours) and Law in environmental protection and municipal economy (8 hours).

While working at the Cracow University of Technology I taught classes in the following subjects: Fundamentals of ecology, Waste management, Basics of environmental protection, Natural foundations of environmental development, Water quality assessment, Environmental engineering, Law in environmental protection, Law and sociology in environmental protection, Reports of environmental impact assessments, Nature protection, Environmental management, Monitoring and environmental assessment. I prepared a program of 30 hours of lectures and 15 hours of projects in the field of Environmental Protection.

I am the supervisor of students associated in the Scientific Circle of Environmental Protection since 2011. Since 2012, every year, students in cooperation with me take part in the Students' Scientific Circle Session (SSKN), preparing papers. I am the scientific supervisor of 24 academic papers prepared by students in 2012-2018. The academic papers prepared by the students received one first place, four second places and four third places, as well as one distinction at the Student Scientific Circle Sessions. In addition, the students cooperating with me took part in field, laboratory and computational research related to the scientific works I prepared. These students have co-authored in five lectures or posters presented at conferences, a chapter in a monograph and twelve articles from the B list and three articles from the JCR list.

I am a supervisor of 14 master's theses and 12 engineering works written by students of the Faculty of Environmental Engineering at the Cracow University of Technology. Two master's thesis and two engineering papers written by my pupils received ‘excellent with outstanding efforts’ grade.

I was nominated for the award in the category "Best educators of the year 2015 in the field of Environmental Protection" by the Faculty Council of Students Council of the Faculty of Environmental Engineering at the Cracow University of Technology.

### 6.2.2 Popularising activity

For many years, I have been spreading and promoting knowledge about broadly understood issues related to environmental protection, as well as the impact of pollution on monuments

Since 2004 I have been organizing annualy additional activities combined with a trip to the Fabric Conservation Laboratory and the Paper and Leather Conservation Studio at the Wawel Royal Castle for students interested in the subject of the impact of pollution on Krakow's monuments.

In 2013, I was a co-organizer of the exhibition on the waste incineration plant in Cracow, as part of the project of construction of the Waste Thermal Transformation Plant (WTMP), implemented under the Infrastructure and Environment Operational Program, priority axis II "Waste management and protection of the earth", measure 2.1 (SIMIK 2007 -2013): POIS.02.01.00-00-005 / 10.

In 2015, the Third National Conference on Light Pollution in Krakow took place, At which event I was the secretary. The purpose of that conference was to present the problem of light pollution in an interdisciplinary approach. Due to a wide range of issues discussed, the conference was divided into a series of thematic blocks. The conference was attended by over 60 participants (including 8 foreign guests from Hungary, Slovakia and Ukraine), 33 papers were presented along with 6 posters The conference was also accompanied by a photo competition, the aim of which was to popularize the subject of light pollution among the general public. I took part in the editorial committee of materials published as part of the 3rd National Scientific Conference on Light Pollution, 25-27/09/2015, Kraków - Niepołomice -Sopotnia (ISBN 978-83-7242-685-7). For the organization of this conference and scientific activity related to the spreading of knowledge concerning light pollution, the research group in the work of which I participated in, has been granted the Team Award of the Rector of the Cracow University of Technology in 2016.

In 2015, I was also involved in three projects related to environmental protection at schools in Cracow. The aim of the first of them, „Eko - zrób to sam kolego" was to prepare workshops on recycling and waste management and to conduct 16 thematic discussions on waste segregation for primary school pupils from primary schools (co-financed by the Office of the Marshal of the Małopolska Voivodeship, contract number: I / 1756 / EK / 2501/15). The second project "Spacerkiem Żółtego Worka" consisted of the preparation of educational materials for teachers of grades I - VI at Cracow's primary schools in the field of environmental protection, waste segregation, recycling, knowledge of nature (co-financed by the Marshal's Office of the Małopolska Voivodship, contract number: I / 1754 / EK / 2499/15). The third project "ELEIS" was aimed at conducting workshops in 15 high schools on the subject of conscious energy consumption and the possibility of saving at home and school (co-financed by the Office of the Marshal of the Małopolska Voivodeship, contract No. I / 1755 / EK / 2500/15).

In addition, in 2015 I gave a lecture at the University of Economics in Poznan as part of the event on EKOinnovations on the subject of "Eco-innovation in cities - lighting counteracting light pollution".

In 2015-2018 I took part, together with students of the Scientific Circle of Environmental Protection in Science Festivals (Rynek Główny, Kraków) in the

organization of the tent of the Faculty of Environmental Engineering at the Cracow University of Technology. At the Science Festival, we popularize knowledge in the field of nature protection, light pollution and waste management.

In 2015-2018, I was giving lectures on smog and light pollution for students of Zespół Szkół Budowlanych nr. 1 in Krakow and in 2018 in the Second High School in Krakow.

In 2017, as part of the scientific conference "650 years of Prokocim", I delivered a speech entitled "The history of the creation of the Bagry Lagoon in Prokocim and the quality of its waters in terms of recreational use" at the Polish Academy of Arts and Sciences in Krakow.

I also gave a lecture on light pollution at the Monday Business Meeting at the AGH University of Science and Technology in June 2018, and a lecture on smog at the ecological conference at TAURON ARENA on 8 October 2018.

Another method of popularizing knowledge in the field of testing and assessing the quality of the water environment and light pollution I realize by writing articles in thematic magazines and journals. In the "Water Management" and "Technology of water" journal, the research group in which I participate publishes articles on the assessment of the quality of the aquatic environment. In contrast, in the journal "AURA - Environmental Protection" another team with whom I cooperate publishes articles on light pollution.

### 6.3 Organizational activity

I was an organizer and coordinator of the Polish-Swiss cooperation concerning the exchange of educators and students between the Cracow University of Technology and the University of Geneva as part of the Erasmus programme in 2005-2008. Each year, we hosted two professors from the University of Geneva at the Cracow University of Technology and two lecturers from the Cracow University of Technology were lecturing at the University of Geneva. In addition, two students attended a four-month scholarship at the University of Geneva and a week-long summer school in Venice.

- I took active part in the organizational committees of three scientific conferences: the Third National Conference on Light Pollution, Cracow - Niepołomice - Sopotnia, 2015;

- the InBuild Scientific Conference, Cracow, 2018;
- the Scientific Conference "650 years of Prokocim", Cracow, 2018.

Together with dr hab. Eng. Agnieszka Generowicz and a group of students, we founded the Environmental Protection Research Group in 2011 and since then I have been the supervisor of students associated in this circle. Together with the students from the circle I participate in the organization of the Science Festival at the Market Square in Cracow and I have participated several times in the organization of Open Days at the Faculty of Environmental Engineering at the Cracow University of Technology. I also took part in the organization of three projects (described above in the section on the popularization of science) in primary schools and high schools. As part of the promotion of the Faculty of Environmental Engineering, I organized meetings for students at schools and at the Faculty of Environmental Engineering of the Cracow University of Technology, in which students from the scientific club actively participated. For students from the science club I also organized trips according to my interests (to WIOŚ, monitoring stations, Institute of Nuclear Physics, conservation workshop at the Wawel Royal Castle as part of additional classes on the impact of pollution on the environment or to collect samples of water, sediments and prepare bioassays).