*Annex 2b*

**Summary of professional accomplishments**

**1. Full name**

Artur Szymczyk

**2. Scientific diplomas and degrees – including the name, place and year of obtaining them as well as the title of the doctoral dissertation**

- Master of Science in Biology, Faculty of Biology and Environmental Protection, University of Silesia in Katowice, Department of Human and Animal Physiology, 1994 – "Accumulation of heavy metals in the tissues of the black-headed gull *Larus ridibundus*" (supervisor Prof. Paweł Migula).

- Doctor of Earth Sciences in Geography, Faculty of Earth Sciences, University of Silesia in Katowice, Department of Physical Geography, 2002 – "Habitat determinants of vegetation succession in disused sandpits" (supervisor Prof. Andrzej Czylok)

**3. Information on current employment in scientific departments**

- doctoral studies at the Department of Physical Geography, Faculty of Earth Sciences, University of Silesia – 1997-2001,

- technician at the Department of Physical Geography, Faculty of Earth Sciences, University of Silesia – 2000-2001,

- assistant professor at the Department of Physical Geography, Faculty of Earth Sciences, University of Silesia – 2002-2014,

- senior lecturer at the Department of Physical Geography, Faculty of Earth Sciences, University of Silesia – since 2014.

**4. Indication of an achievement* under the Art. 16 par. 2 of the Act of 14 March 2003 on degrees and titles in science and on degrees and titles in the Arts (Journal of Laws No. 65, item 595 as amended)**

**a) Title of scientific achievement**

I submit the full publication as an achievement under the *Act* (Art. 16.1 Section 2.1 of the *Act*)

**b) Author/authors, title/titles of publication, year of publication, name of publisher**

Artur Szymczyk, 2015. "Relations between communities of carpological macroremains and contemporary vegetation of small, shallow reservoirs - Representation of modern vegetation and distribution of macroremains in deposits of selected reservoirs of the Silesian Upland." Scientific Papers of the University of Silesia in Katowice, Series: Earth Sciences. University of Silesia Press, Katowice, pp. 175. ISBN: 978-83-8012-396-0, ISSN: 0208-6336

**c) Discussion of the scientific objective of the paper and its results, together with a discussion of their possible use**

In my habilitation dissertation I undertook a rarely considered topic concerning the relationship between communities of plant carpological macroremains and contemporary vegetation, which is important for the interpretation of the results of plant macroremain analyses. My main goal was to determine the extent to which communities of carpological macroremains saved in the top layer of sediments reflect contemporary vegetation and what factors have a decisive influence on the formation of taphocoenoses. In contrast to the previous few studies that focus on the representation of only selected groups of plants, my research included the analysis of the whole flora present today in the water bodies and within 100 m from them. I also drew my attention and tried to explain the participation of species related to crops and ruderal habitats in the communities of carpological remains, usually ignored in previous studies. In comparison with other papers, my analyses relate to the items which - due to their characteristics - can be considered as a model for the terminal stages of the development of ancient lakes.

***Scientific problems and research goals***

Plant macroremains have been used in research since the nineteenth century. Since the introduction of the quantitative approach to their studies in the middle of the twentieth century (West 1957), the analysis of plant macroremains has become one of the most important and most commonly used methods for the reconstruction of the paleo-environment. Plant macroremains, including carpological remains, are commonly used to reconstruct the changes of the phytocoenoses (Sayer et al. 1999, 2010a,b, Birks 2000, Odgaard & Rasmussen 2001, Lamentowicz & Milecka 2004, Milecka 2005), to reconstruct temperature changes (Kolstrup 1979, Isarin & Bohncke 1999), trophy changes (Jackson & Charles 1987, Scheffer et al. 1993), and the level of the lakes in the past (Digerfeldt 1986, Hannon & Gaillard 1997, Yansa & Basinger 1999, Schubert 2003, Dieffenbacher-Krall & Nurse 2005, Koff et al. 2005, Väliranta 2006). Their analyses often enable assessing human impact on the environment (Rasmussen & Anderson 2005), and are used in archeology (Lityńska-Zając & Wasylikowa 2005). Today reconstructions of the recent past of lacustrine environments are increasingly performed to obtain valuable data for the rational planning of protection and revitalisation of lake ecosystems (Konieczna & Kowalewski 2009). The interpretative potential of plant macrofossils (Birks 1980, 2003, Mannion 1986, Wasylikowa 1986, Dieffenbacher-Krall 2007, Kowalewski 2007), makes their study a very valuable source of paleobotanical data. Unlike pollen, macroremains can be more frequently identified at the species level (Birks 1980, Birks 2007), thus the data obtained through their research are an important complement of palynological analyses (Birks & Birks 2000, Tobolski 2000, Birks 2003, 2007, Żurek 2010). In many cases the combination of these methods allows for a more complete spectrum of species of local flora than using only the palynological analysis. As a result, a greater number of species that can be used to interpret paleoenvironmental conditions potentially enables to analyse more parameters; additionally, they can be more precisely recognised. The great importance of macroremain analyses for paleoenvironmental research is also proved by the fact that macroremain communities in lake sediments - in contrast to the pollen spectra - usually reflect only the local vegetation (Birks 1980, Tobolski 2000), which means they can be referred to specific objects and their immediate environment.

The main interpretation issue of macroremain analyses in paleoenvironmental reconstructions, primarily those aimed to determine the species diversity of flora, spatial distribution of past phytocoenoses and dominant species, is the fact that they rely not only on

the application of knowledge about the ecology of individual species, but also on the complex and still poorly known relationships between macrofossil communities and contemporary vegetation (Birks 2001, Dieffenbacher-Krall 2007). These relationships determine the level of contemporary vegetation representation and distribution in sediments, as well as the abundance of macroremains of individual species. As a result, they can be considered to be crucial, especially for assessments in quantitative terms. Their better understanding, also postulated by other researchers (Zhao et al. 2006, Dieffenbacher-Krall 2007), not only provides the opportunity to clarify and broaden the interpretation of data obtained from the macroremain analyses, but also allows for better planning of paleolimnological research. Depending on the undertaken issue, it allows, among others, selecting a suitable lake and the best sampling location, as well as estimating the number of samples necessary for the research (Dieffenbacher-Krall 2007). Among the important issues of macroremain research is a large spatial variability in the distribution of plant macrofossils in sediments (Birks 1973, Davis 1985, Hill & Gibson 1986, Dieffenbacher-Krall 2007). This causes that their communities within the lake basin may differ substantially in terms of both quantity and species composition (Tobolski 2000, Dieffenbacher-Krall & Halteman 2000, Presthus-Heggen et al. 2012). One of the most important reasons for this variability is the segregation of diaspores occurring during the transportation of seeds and fruits to the place of their deposition (Grime 1989), resulting primarily from their diverse structure and a related variety of forms of dispersal. Therefore, besides the processes affecting the fossilisation and preservation of seeds and fruits in sediments, very important from the point of view of research of carpological remains, the correct interpretation of the analyses and the selection of the sediments sampling site, is also advancing the knowledge about the role of the strategy of dispersal of diaspores and the influence of different features of lake ecosystems, which ultimately determine the place of their deposition and their quantity. These include the size of the lake basin, its depth, diversity of the shoreline, slope as well as the level of development and distribution of vegetation and the presence of animals. These features vary from lake to lake, but they also evolve along the entire lacustrine ecosystem and often become common and specific to particular stages of the development of lakes.

Studies of the relationship between contemporary phytocoenoses and forming taphocoenoses, as well as the analysis of the impact of conditions in the lake basins on these processes are possible by testing samples of surface sediments (Dieffenbacher-Krall 2007). The results of the few to date studies of the top sediments suggest that the clusters of

macroremains generally reflect well the structure of the contemporary vegetation. In some cases, they even allow determining the dominant species, but usually they do not give a complete picture of species diversity of former phytocoenoses (Dieffenbacher-Krall 2007, Szymczyk 2010, 2012). So far, the research on the taphonomy of plant macroremains which compared contemporary vegetation with macroremain communities in the top sediments have focused on the representation and distribution of the remains of only selected groups of plants. Mostly these were aquatic taxa (Birks 1973, Davis 1985, Dieffenbacher-Krall & Halteman 2000, Zhao et al. 2006, Koff & Vandel 2008), while terrestrial taxa were less often described (Dunwiddie 1987, Wainman & Mathewes 1990). In addition, most of the studies taking up the issue of the relationship between the macroremain communities and contemporary vegetation were conducted either in relatively shallow lakes of medium size (Birks et al. 1973, Zhao et al. 2006), or in larger and deeper lakes (Dieffenbacher-Krall & Nurse 2005, Koff & Vandel 2008, Presthus-Heggen et al. 2012). Additionally, the macroremain communities in today's sediments of shallow overflows in river deltas were analysed (Hall et al. 2004). Compared with the previous studies, my research, which I started in a small lake in Sławków (Szymczyk 2010, 2012), refer to the relationships prevailing in much shallower reservoirs, whose depth - besides small deeps - does not exceed 1.5 meters and which have well-developed rush and water vegetation. The features of these reservoirs, such as strong shallowing, gentle relief of the bottom and strong growth of vegetation, are characteristic mainly for the terminal stages of the lakes. Therefore, the relationship between vegetation and communities of carpological remains, which I observed in such lakes, may be representative of the ancient reservoirs in the last phase of their development. The study presented in my paper was conducted in four water bodies. Three of them were small and very shallow water bodies in subsidence basins; for comparative purposes the fourth one was a larger and deeper reservoir located in a disused clay pit. The discussion also took into account the results of the research of the Sławków reservoir (Szymczyk 2010, 2012). My research, in contrast to the previous ones focusing on the representation of selected groups of plants, included the analysis of the entire flora present today in the reservoirs and up to 100 m away from them. I also analysed the presence and tried to explain the participation of the species related to crops and ruderal habitats in the communities of carpological remains, usually ignored in previous studies, the presence of which may carry important information about human activity in the vicinity of the ancient reservoirs.

Being aware of the existence of many factors that affect the representation and distribution of carpological remains in sediments, when conducting the study I tried to answer the questions how true the picture of flora of shallow lakes and their surroundings obtained from analysing plant macroremains is and which factors decide about that? **Therefore, my main goal was to determine the extent to which communities of carpological macroremains preserved in the top layer of sediments reflect contemporary vegetation and what factors have a decisive influence on the formation of taphocoenoses.**
I formulated the following subobjectives: (1) Checking whether anthropogenic reservoirs can be model objects to study processes of formation of taphocoenoses of plant macroremains.
(2) Assessing the extent to which the species composition of communities of carpological remains reflect the species composition of modern vegetation. (3) Evaluating whether the abundance of the diaspore of individual species found in samples of deposits reflects the proportions of their coverage in today's phytocoenoses or whether at least the number of diaspores reflects the dominance of certain species of particular groups. (4) Recognising the key factors determining the distribution and abundance of carpological remains in small and shallow water bodies. (5) Recognising new - and verifying the already signalled in the literature - relationships between contemporary phytocoenoses and distribution and abundance of carpological remains, which are helpful in the paleolimnological interpretation.

***Research results and their importance***

The achieved results have both cognitive and application dimension. They make an essential contribution to the study of plant macroremains deposited in top lake sediments. Studies of this type allow acquiring knowledge to improve the interpretation of macroremain analyses, and the use of their results can help to increase the interpretive capacity and reliability of paleoecological and paleoenvironmental research. In the wider dimension, the results of the research may also be useful and relevant to the research and studies referring to the past of the reservoirs of biogenic accumulation in the context of nature conservation. This also involves legal EU requirements, such as the Water Directive and the need to ensure good quality water in a short time, as well as the need to determine the reference conditions of individual objects and the tasks of nature conservation in the Natura 2000 areas.

The studies include numerous observations on the dispersal and behaviour of diaspores after getting into the reservoir basin. As such, in the context of their practical use,

they help answer the following questions relevant to the interpretation of the macroremain analyses, at least in terms of species covered by the analysis:

**(1)** What image of ancient floras do we observe when analysing plant macroremains, or what percentage of the total number of species building old phytocoenoses could potentially be represented in the sediment? **(2)** Which ecological groups of plants are better represented? **(3)** How do the distance of parent plant stands from the reservoir basin, the manner of their dispersal and ecosystem characteristics affect the ability and the potential level of representation of the individual species? **(4)** How does the location of the sediment sampling affect the macroremains abundance and their species diversity? **(5)** Which of the species have a tendency to over-representation and which to under-representation in the communities of carpological remains, and which are "easier" and which "more difficult" to detect in sediments, e.g. if the sampling rate of the reservoir is lower? **(6)** The participation of diaspores of which species in communities of carpological remains best - and which worst - reflects their role in building parent phytocoenoses? **(7)** What is the impact of the multiple-fold increase of the number of analysed sediment cores on the detection of species building past phytocoenoses?

The values of the present study, as well as its research achievements, include:

**(1)** Both qualitative and quantitative research results in the following terms: participation of individual remains accumulated in the sediments at the bottom of the reservoir; representation of contemporary vegetation, including various ecological plant groups, in the sediments; as well as the abundance of diaspores and carpological remains depending on the location of sampling sites. **(2)** The pioneering character of the research range of the analyses which included the entire flora occurring today in the reservoirs and at a distance of up to 100 m from them. **(3)** Referring the test results to the specifically defined complex of common features of the reservoirs, in this case typical of lakes in the terminal phase of their development. **(4)** Undertaking an attempt to explain the effect of different factors (including morphometric features of reservoir basins, adaptation of diaspores to dispersal and to certain features of ecosystems, such as the distribution of vegetation and the degree of the bottom coverage) on the distribution and abundance of macroremains of individual species and their groups, the understanding and consideration of which may expand the interpretive possibilities of the macroremain analyses.

The research I conducted allowed for drawing the following specific conclusions:

Anthropogenic water reservoirs, including those developed in subsidence basins and post-exploitation clay pits, can be model objects for the observation of the processes of the formation of taphocoenoses in the reservoirs that are either in their terminal stages of development or at earlier stages of their evolution.

Both in small, very shallow reservoirs as well as in larger and deeper ones, the key factors determining the distribution of carpological remains of individual species within the basin include: (1) the ability of diaspores to remain on the surface of the water, (2) the dispersal method, (3) the size of diaspores, their shape and structure, and in particular the presence of various types of spikes and hooks, (4) the distribution of rush and water vegetation, as well as the coverage of the bottom with vegetation, (5) the shape of the reservoir basin, (6) the presence of animals, mainly birds and fish, (7) the ecosystem properties which may affect the formation of the phenomena favourable to transport or redeposition of remains, including algae mats.

Macrocarpological remains showed a general tendency to concentrate in the contact zones with the belt of rushes. In all the reservoirs the samples collected in the coastal zone showed a higher participation of remains and a greater species diversity than those collected in the central parts of the basins.

In the case of the rush plants and those associated with the belt of rushes, most diaspores (53.1% to 59.5%) were deposited in the shore samples. Similarly, in the case of trees and shrubs, the analysis showed that in three studied reservoirs the percentage of the carpological remains found in the samples of the coastal zone ranged from 60% to 71%. Only in one reservoir most of the diaspores were deposited in the central parts of the basin, which should be associated with their capture by vegetation patches, the shoots of which reached the surface of the water. In the case of aquatic plants, the distribution of carpological remains in the samples was different than for rush plants. In the three surveyed reservoirs most of their diaspores (56.4% to 83.7%) were found in the samples of the central part of the basin. Only in one reservoir the majority of diaspores (64.7%) of aquatic species came from the shore samples. The reason for this was the concentration of the numerous *Batrachium circinatum* patches represented in macroremain communities in the lake coves where the samples were collected. The distribution of carpological remains of terrestrial plants in the basins of reservoirs varied, and depended largely on the ability of diaspores to float on the water surface and the way of their transportation to the basin. The diaspores of the wind-dispersed

species were generally deposited at the shore, while the species of the zoochorous species - accidentally near the places to which they were supplied by birds.

In all the reservoirs the largest macroremain communities came from the coves situated among the reeds and in shallow waters, often covered with patches of *Eleocharis palustris*. These places were a trap for the floating diaspores. In the shallow parts of basins numerous were communities of macroremains from the samples located in small depressions of the bottom and in the immediate vicinity of the dense patches of submerged vegetation, which constituted a barrier to the movement of diaspores along the bottom as a result of microcurrents induced by feeding birds or fish.

The concentration of carpological remains of some species can be caused by the whole "packages" of seeds or fruit getting into the reservoir, which formed as a result of getting wet (*Typha* sp.), due to molding by cobwebs (*Epilobium* sp., *Sparganium erectum*), tacking of fruit (*Eleocharis palustris*) or burying whole fruit stalks (*Phragmites australis*).

The most important for the distribution of carpological remains within the basins of reservoirs proved to be the differences in the size, depth and shape of the reservoir shores and bottom and, above all, differences in the vegetation coverage. The steep shores of a larger and deeper reservoir meant that particularly small, light and quite quickly sinking diaspores of *Mentha* sp., *Juncus* sp. and *Stelllaria uliginosa* were transported across the bottom even 10 m to 30 m further than in the shallow reservoirs of gentle shores.

In small shallow reservoirs in the terminal stages of their evolution, the impact of vegetation on the dispersion of the floating diaspores is particularly important because their characteristic feature is strong growth of vegetation. Rushes, emergent stems of aquatic plant and leaves of nymphoids intercept drifting seeds and fruits, and thus limit their migration; this results in the concentration of diaspores on the edges and within the dense vegetation patches in the central parts of the basins. This causes their more even distribution. From the point of view of the paleolimnological research, insufficient sampling of the basins of such reservoirs can reduce the probability of detecting the species whose range in these basins is limited. At the same time, however, due to the inhibition of migration of diaspores, the macroremain communities here may better reflect the position of native vegetation patches.

The possibility of scattering diaspores in a wider area, characteristic of the species whose seeds and fruit are dispersed by water, wind or birds, makes them easier to detect at the weaker sampling of the deposits. In small overgrown reservoirs the species of anemochorous

dispersal of seeds are specifically advantaged; they were frequently detected in 50% of the analysed samples.

Considerable participation of diaspores adapted to long floating on the water - comparable to this observed in shore samples, and including the *Carex* fruit, Betula fruit and fruit husks and *Alisma plantago-aquatica* seeds, was recorded in the samples of the sediments collected in the central part of the reservoir, may indicate a shallow reservoir in the paleoenvironmental studies.

Diaspores of plants, such as *Ceratophyllum submersum*, *Najas marina*, *Zannichellia palustris*, *Scutellaria galericulata*, *Bidens tripartita*, *Lythrum salicaria*, *Scirpus sylvaticus* and *Scutellaria galericulata*, concentrate in a smaller area and best indicate the location of the sites of parent plants. In contrast, fruits and seeds of such species as *Myriophyllum spicatum*, *Potamogeton crispus*, *P. lucens*, *Eleocharis palustris*, *Mentha aquatica* and *Schoenoplectus tabernaemontani* are generally more dispersed and can be found at a greater distance from the parent plants. In their case the location of patches of native vegetation is indicated by a statistically significant concentration of carpological remains rather than a single seed or fruit. In contrast, places of the contemporary presence of algae *Chara* sp. were well indicated even by an insignificantly increased concentration of oospores, amounting in the analysed reservoirs to over 100 oospores per 100 $cm^3$ of the sediment.

Representation of individual species in macroremain communities depends primarily on the number of parent plants, the number of diaspores produced by them, durability of those diaspores and their dispersal manner. At the same time, studies have confirmed that the number of diaspores found in sediments does not accurately reflect the quantitative ratios among native vegetation, but generally well reflects the species composition of parent phytocoenoses.

The results have shown no direct relationship between the size and depth of the reservoir and the level of representation of contemporary vegetation in macroremain communities. However, representation of plant macroremain communities differed, both in relation to particular ecological groups, and in relation to all plants found in individual reservoirs and in their vicinity. For the total flora present within a radius of 100 meters from the reservoir, the level of representation was up to 43.5%.

In general, depending on the reservoir, best represented plant groups were associated with a rush zone (maximum 78.8%) or water plants (up to 76.9%). The poorest representation was recorded for trees and shrubs (up to 28.6%), and plants of terrestrial habitats (up to

28.9%). Representation of plants associated with the terrestrial habitats was dependent on the distance at which native vegetation grew and the presence of a rush zone, which acts as a filter intercepting seeds getting into the reservoir with the surface runoff. Best represented was a group of species growing within the basin of the reservoir. In contrast, a group of species growing outside the reservoir basin was very poorly represented and only by the diaspores of the anemochorous and zoochorous species. Despite the relatively low representation of terrestrial plants, particularly species growing outside the basin reservoir, it should be recognised that the presence of their diaspores was a good indicator of the presence of terrestrial habitats, including ruderal ones, within 100 m from the endorheic basins of the reservoirs.

In each of the analysed reservoirs a single sample with the most diverse species composition of macroremain communities was located near the shore. Similarly as in the total number of samples, also in a single sample with the maximum number of species the best represented were the groups of aquatic plants (up to 50%) and those associated with the rush zone (up to 51.5%). Trees and shrubs (up to 21.4%) as well as terrestrial plants (up to 11.3%) had the poorest representation. For all the groups of plants in the tested reservoirs the share of species represented in a single sample was much lower than for the total number of samples. These studies also show that in small reservoirs increasing the number of cores a few times may result in detection of up to 20% species more.

The role in building modern phytocoenoses was best reflected by the participation in macroremain communities of diaspores of such species as *Bulboschoenus maritimus Carex* sp., *Lysimachia vulgaris, Najas marina*, *Persicaria amphibia*, *Sparganium erectum*, *Rumex crispus* and *Zannichellia palustris*. However, the species composition of the carpological remains of *Carex* sp. in the communities from outside the zone covered with rushes reflects the participation of the various species in the structure of only the internal reed belt, in contact with the water surface. The representation in modern phytocoenoses was well corresponded to the quantity of the carpological remains of *Bidens tripartita*, *Glyceria maxima*, *Lycopus europaeus*, *Lythrum salicaria*, *Mentha* sp., *Myriophyllum spicatum*, *Rorippa palustris*, *Rumex hydrolapathum*, *Schoenoplectus tabernaemontani*, *Scutellaria galericulata*, *Stellaria media*, *Persicaria amphibia*, *Rumex hydrolapathum*, *Sonchus* sp. and the species of the genus *Potamogeton*. Those poorly represented species included: *Ceratophyllum submersum*, *Eupatorium cannabinum*, *Epilobium* sp., *Lemna* sp., *Salix* sp. and *Populus* sp. In contrast, species such as *Alisma plantago-aquatica*, *Batrachium* sp., *Betula* sp., *Chara* sp.

*Chenopodium rubrum*, *Eleocharis palustris*, *Juncus* sp., *Polygonum lapathifolium*, *Ranunculus sceleratus, Rannunculus* sp., and *Stellaria uliginosa* were usually overrepresented in small reservoirs, while the abundance of their diaspores in the larger and deeper reservoir better reflected their participation in the modern-day phytocoenoses. In the case of anemochorous species of the genus *Cirsium*, a large area of open water was a trap capturing more wind-borne diaspores, which meant that in a large reservoir they were overrepresented.

The studies have shown that an explanation of the role of *Typha* sp. in the creation of the former phytocoenoses requires the palynological analysis as well as the analyses of vegetative remains, while in the case of *Phragmites australis* and the species of the genus *Ceratophyllum* – the analysis of vegetative remains.

The results of the research confirmed that the carpological remains of plants are a very important source of paleolimnological information. They generally well reflect the local vegetation and - in some cases - can be used to identify taxa dominant in the past. At the same time, however, they indicate that - due to many factors, different for individual species, which influence the production of diaspores on the one hand, and their transportation and fossilisation on the other hand - the analysis of multiple samples may not precisely determine the species composition of parent phytocoenoses and may allow limited assessment of the quantitative ratios. Therefore, in order to obtain the fullest possible picture of past phytocoenoses, the analyses of carpological remains should be supplemented with palynological analyses and determining vegetative remains.

## 5. Discussion of the other scientific and research achievements

### *The course of scientific work and discussion of the scientific and research achievements before obtaining a doctoral degree*

My initial interest in bird watching, and later ornithology, and the influence of environmental changes on the avifauna, which appeared still in elementary school, brought my first contact with the scientific research already in 1984. From the engagement of reading rings of mute swans *Cygnus olor* wintering in Silesia, I started my cooperation with the researchers from the Ornithological Station of the Institute of Ecology of the Polish Academy of Sciences in Gdańsk. Most of all, it allowed me to develop my interests and gave the opportunity to learn the current trends and issues of the ornithological research. It also

enabled my participation in the research programs. The most interesting were the studies of the population of sandwich tern *Thalasseus sandvicensis* breeding at the mouth of the Vistula and the study of the national population of mute swan in which I took an active part for a few years. It consisted of, among other things, ringing of nesting and wintering birds. At the same time, in 1986, as a volunteer, I started cooperation with the Ornithologists' Club of the Małopolska Region and - after learning the field research methodology - I eagerly participated in projects carried out in the Laboratory of Birds' Biology of the Institute of Zoology of the Jagiellonian University. The most important one included quantitative and qualitative research of the breeding avifauna of the Bieszczady PN as well as the studies of the population of wintering and breeding birds of the Małopolska region. The results of my several years' of observations conducted in several research areas were used in the preparation of the Atlas of Breeding Birds of Małopolska 1985-1991, which was published in 1992 (Walasz, Mielczarek 1992), and which mentioned my name within the team of researchers. The results of my research conducted at that time in the area of the Kozłowa Góra reservoir were considered in the publication "Bird Refuges in Poland", which appeared in 1994 (Gromadzki et al. 1994). In the years 1987-1994, mainly in cooperation with the "Index of nests and breeding", I participated in the studies of the Ornithologists' Club of the Silesia Region, coordinated by the Department of Behavioural Ecology of the Faculty of Biological Sciences at the University of Wrocław. At that time I was also a member of the Katowice Club of the Ornithological Section of the Polish Zoological Society. On numerous occasions I took part in ornithological research camps organised by the Laboratory of the Birds' Biology of the Institute of Zoology of the Jagiellonian University and the Ornithological Station of the Ecological Institute of the Polish Academy of Sciences. I also participated twice in the studies of the Baltic Action (Kopań and Vistula Spit), coordinated by the University of Gdańsk.

After graduating from the Power Engineering Technical School in Sosnowiec I began studies at the Faculty of Biology and Environmental Protection in Katowice. In the course of my studies, my interest still focused on ornithology, but it gradually widened to cover the issues related to the functioning of ecosystems under anthropopressure. I got especially interested in hydrogenic ecosystems often forming or operating in the conditions of the Silesian Upland in the areas deformed by human activity. The result of combining these interests was my master thesis which compared the accumulation of heavy metals in the tissues of black-headed gull *Larus ridibundus* of two populations with assumed different exposure to contaminants, written under the direction of Prof. Paweł Migula at the

Department of Human and Animal Physiology, the Faculty of Biology and Environmental Protection of the University of Silesia. The results of this study, part of a wider project I co-authored, were published in the journal "Acta Ornithologica" (Migula et al. 2000).

While still a student I started to work (from 1994 to September 1997) at the Management Board of the Landscape Parks Complex of the Śląskie Voivodeship as a nature conservation specialist. This work gave me the opportunity to develop my interests and my knowledge of the practical aspects of nature conservation. It also allowed me to participate in the research projects of the Management Board of the Landscape Park Complex and enabled to conduct my own, including the projects referring to planning for the protection of valuable natural objects. These included:

(1) The program of active protection of "Bagna Błędowskie." (2) Qualitative and quantitative studies of bats hibernating in the caves of the Jura Landscape Park Complex. (3) Inventory of the sites of barn owl *Tyto alba* in the sacral objects of the Jura Landscape Park Complex and the assessment of the current state of its population. (4) Studies of the avifauna breeding and wintering in the Jura Landscape Park Complex. (5) Determining threats to the areas valuable from the point of view of the diversity of the avifauna of the Jura Landscape Park Complex.

Part of the research results was later, during my doctoral studies, published in the monographic paper on birds and areas valuable for the preservation of the diversity of bird fauna in the area of the Jura Landscape Park Complex and threats to them (Szymczyk 1998a), as a chapter in a popular science paper concerning the diversity of fauna of the Wodąca Valley in the Smoleńsko-Niegowonickie Ridge (Szymczyk 1998b), as well as in an article on the distribution of the sites and population status of barn owl in the area of the Jura Landscape Park Complex (Szymczyk 1999b).

Regardless of the above, in the years 1996 and 1997, I wrote 11 articles which were published in the monthly magazine "Green League", published since 1995 by the Upper Silesian Publishing House and popularising knowledge about nature, environment and environmental education. These were mainly articles dealing with the issues of synanthropisation of animals and regarding the ecology of selected species.

After starting the doctoral studies in 1997 time limitations constrained me from engaging in the ornithological problems; the main issues within my interest were those related to regeneration and functioning of ecosystems in the areas deformed as a result of anthropopressure. However, in 1998, thanks to the cooperation with the Faculty of Earth Sciences, University of Silesia with the Management Board of the Landscape Parks Complex,

more opportunities appeared for research in the karst areas, also thanks to the possibility to use the facilities of the scientific and educational centre in Smoleń. As suggested by Prof. Marian Pulina, I decided to deal with the issues relating to the modifying effect of vegetation and soil cover on the physicochemical properties of rainwater infiltrating karst systems as part of my doctorate. Unfortunately, despite the development of effective methods of collecting water that passes through the soil cover and obtaining satisfactory initial results of the analyses, we failed to secure funding for the further stages of the project in a timely manner. This forced me to abandon this project and - richer in new experiences - I returned to the research of my mainstream interests. I paid particular attention to the processes of succession and spontaneous formation of hydrogenic ecosystems in the post-exploitation areas flooded with waters coming from the aquifers dissected during operation. The most important area of my research were large post-exploitation sandpits in the eastern part of the Silesian Upland. These were mainly the following sandpits: "Pogoria", "Siemonia", "Kuźnica Warężyńska" and "Maczki Bór". Earlier research in such areas (Czylok & Rahmonov 1996, 1998) pointed to the possibility of forming valuable natural ecosystems in the waterlogged bottoms of the workings, which were habitats of many rare plant and animal species. Determining the factors key to their formation could be important not only in the cognitive terms, but also in practical terms, as it could allow to predict the time and direction of plant succession in newly ceased sandpits, thus these issues struck me as extremely important. Therefore, the main purpose of my further research and my doctoral dissertation titled "Habitat conditions of plant succession in the post-exploitation sandpit workings," was to recognise the relationship between the habitat determinants and the vegetation developing in the sandpits and the directions of its succession. For the studies, conducted between 1997 and 2001 in variously-aged excavations, I assumed that succession sequences in different sandpits are repetitive in similar habitat conditions. The studies that I started in four selected disused sandpits included studies of habitat conditions of the workings' bottoms (topoclimate of the excavations, microclimate of the excavations surface, soil temperature at the depth of 50 cm of the profile, grain size composition of the substrate, temperature and physicochemical properties of water flooding bottoms of the excavations), the study of flora and the directions of its transformation (floristic studies and phytosociological analyses), as well as some of the features of the developing soil cover (analysis of soil profiles in variously-aged surfaces with varying degrees of wetness collected at the distinctive plant communities, and the study of some physicochemical properties of soils).

The research helped me to draw a number of conclusions. For example, apart from the overriding influence of the geological structure and macroclimate, I found out the most important factors directly and indirectly influencing the species composition of the emerging phytocoenoses and directions of their changes include terrain, the water table level and physicochemical properties of water flooding the excavation bottoms. Therefore, adapting the water table level and water's physicochemical properties as criteria, I classified habitats found in the excavations, which reflects the diversity of vegetation in the initial stage of overgrowing of disused sandpits. For individual habitat categories I have described the succession directions. The results of research conducted within the framework of a doctorate were presented at national (K.18, K.19, K.20 i A.1, A.2 i A.3 - Annex 5) and international (K.4) conferences. They were also included in later publications that I authored (Szymczyk 1999b) or co-authored (Szymczyk et al. 2003, Czylok et al. 2008, 2009, Rahmonov & Szymczyk 2010, 2011; Szymczyk & Rahmonov 2010, Szymczyk et al. 2011, Banaszek & Szymczyk 2014). They also served as the source material for further research on the excavations, this time in team projects, the results of which were published in journals from the MNiSW list (Czylok at al. 2008, Rahmonov & Szymczyk 2010).

Besides the main stream of research to form the basis of a PhD dissertation, during the doctoral studies I participated in projects conducted at the Department within its statutory research. They were:

"Relations between biocoenoses and elements of inanimate nature in the protection zone of the Katowice Steelworks in the area of Sławków" (1998).

"Changes in biocoenotic systems in the areas of weakened human pressure" (1999-2000).

Participation in numerous field studies carried out in teams, mostly under the guidance of Prof. Czylok, allowed me not only to deepen the knowledge on the functioning of the environment, but above all taught to see their relationships in practice. The results of these studies were also the basis for implementation of projects (Annex 4) which I co-authored. These works generally had a character of a valorisation of natural valuable or protected areas, including general areas and faunistic areas, as well as those which were the basis for the appointment of new legally protected areas.

***The course of scientific work and discussion of the scientific and research achievements after obtaining a doctoral degree***

After receiving the doctoral degree, my research continued to address the issues shaping the functioning of ecosystems and opportunities of their protection in the areas deformed as a result of anthropopressure. I conducted them mostly within the statutory research projects carried out in the Department of Physical Geography. However, the experience gained during the course of doctoral studies, especially the observation of initial stages of the peatbogs formation, succession developing in sandpit reservoirs and observations of regeneration of peat ecosystems in partially depleted peat pits, meant that in 2004 my interest turned towards the issues related to the evolution and changes in the ecosystems in the past, and later the analyses of macroremains, and finally taphonomy of plant macroremains. After 2006 these issues dominated my scientific work, and the research on the factors determining the distribution of plant remains in lake sediments have become the subject of my post-doctoral dissertation.

The direct impetus for interest in the paleobotanical studies appeared during the research conducted with a team of employees of the Faculty of Earth Sciences, University of Silesia, aimed at - among other things - finding the most valuable natural objects in the area of the Landscape Park “Forests of the Upper Liswarta”. During these studies a hypothesis was put forward about the natural origin of the reservoir "Jezioro" in the village of Jezioro near Herby. In the light of it, this would be the only natural reservoir besides oxbow lakes of the Woźnice-Wieluń Upland, and the series of sediments could represent the entire Holocene. The results of the research on the current state of peatbog ecosystems at this site were announced at the conference (K.15 - Annex 5) and published already in 2004 (Czylok et al. 2004). However, the potential interpretation value of the deposits meant that the team decided to conduct interdisciplinary paleoenvironmental research of the site in the future. The research of "Jezioro" turned my interest for good to the reconstruction of the lacustrine-peatbog paleoenvironments and macroremain analyses. Mastering the methods of interpretation of macroremain analysis was easier for me thanks to the previously acquired knowledge and experience in the field of plant ecology and functioning of hydrogenic ecosystems. Additionally, Prof. Sławomir Żurek from the Department of Quaternary Paleogeography and Nature Conservation of the Świętokrzyska Academy in Kielce shared his experiences and knowledge in the practice of collecting deposits and their description. Thanks to him, in 2006

I could improve my field skills and learn by observing field research conducted by Professor at the sites by Lake Białe near Gostynin. The first experience with the macroremain analysis I gained in the Department of Paleobotany of the Institute of Botany of the Polish Academy of Sciences in Kraków, where Prof. Renata Stachowicz-Rybka gave me valuable tips during my first independent work. Thanks to the courtesy of Prof. Ewa Zastawniak-Birkenmajer I could also benefit from the comparative collection gathered in the Department.

In 2007, the interdisciplinary research of the "Jezioro" site in the village of Jezioro were resumed and my participation in them included the selection of the sampling site and collecting core deposits, conducting macroremain analysis and interpretation of the results of paleobotanical analysis, which I conducted in cooperation with Prof. Małgorzata Nita, who carried out the palynological analysis. It turned out that the beginning of the operation of the reservoir reaches the Late Vistulian, and the series of deposits of this site is a continuous sequence representing the time period from the Younger Dryas to Subboreal. Sediments, which consisted initially of silts (Younger Dryas), later gyttias (Preboreal to Subboreal) and finally at the end of the Subboreal of peat, contained rich macroremain flora which presented a complete history of vegetation of over 11 000 years. They allowed for the delimitation of seven levels of macroremains, as well as the detailed reconstruction of the evolution of vegetation and the changes of the lake's trophy from the mesotrophic to oligotrophic to dystrophic. They also helped in determining the origin of the lake and the water level changes. The described site is especially valuable for the interpretation of the environmental transformation of southern Poland. It may also be important for drawing conclusions about the Holocene changes in geographic range of some plant species in Poland, including *Betula nana*, which currently grows in Poland in a few patches, and *Nuphar pumila*, whose Polish sites currently determine its southern range. Its value comes from the fact that the region of the Silesian-Krakow Upland has very few reservoirs of biogenic accumulation. The previously known and described were only a few sites with the sediments representing the Late Pleistocene and Holocene, including only two with complete lithostratigraphic series: in Wolbrom (Latałowa & Nalepka 1987), and in Jaworzno (Szczepanek & Stachowicz-Rybka 2004). Additionally, in the 1990s the profiles of the Bąków (Mamakowa 1997) and Bronów (Granoszewski 1998) were described, but the detailed results of their research have not been published so far. In 2011 the fourth profile of the peatbog of limnic genesis in Krzywopłoty was described (Żurek et al. 2011); this is where the sedimentation of the bottom gyttia began in the Younger Dryas or even in Alleröd. The detailed results of the macroremain and

palynological analyses of the "Jezioro" site on the transformation of vegetation on the background of the forest history were published in 2010 (Nita & Szymczyk 2010). Two years later, the article summarising the entire interdisciplinary research was published in the "Journal of Paleolimnology" (Fajer et al. 2012). The preliminary results were also successfully presented at national (K.15, K.21, A.4 - Annex - 5) and international (K.7, A.3 - Annex - 5) conferences.

A small number of the sites of the Late Glacial and Holocene flora described in the Silesian-Krakow Upland prompted me to conduct a wider project as part of my own research in 2008. Its title was "The functioning of lacustrine-peatbog ecosystems of the Silesian-Krakow Upland during the Late Pleistocene and Holocene" (No. BW 14/2009 and BW 14/2009). My main goal was to identify new sites and reconstruct the Late Pleistocene and Holocene changes of the lacustrine and peatbog environments of the Silesian-Krakow Upland. The obtained funding allowed not only to continue the research at the "Jezioro" site, but also made it possible to start the research and dating of sediments from other sites: "Peatbog in Korzonek" near the village of Korzonek and "Peatbog in Brzozowiec" near the village of Brzozowiec. These research sites are located approximately 12 km from the previously discussed "Jezioro." They include small, partially exploited peatbogs. Preliminary results suggest that the accumulation of the series of organic deposits began in them much later than in "Jezioro", i.e. at the end of the turn of Preboreal and Boreal. The character of their deposits and the analyses of their quite diversified plant macroremains indicate the terrestrial genesis of the peatbogs and, in the case of the "Peatbog in Korzonek", a short limnic phase in their history. The development of the floras of these sites and analysis of the vegetation changes will supplement the data obtained at the "Jezioro" site, and will make an important contribution to understanding the functioning of environments of the Silesian-Krakow Upland in the Holocene. The results of the paleobotanical analyses from the sites "Peatbog in Korzonek" and "Peatbog in Brzozowiec" are currently being prepared for print in collaboration with Prof. Małgorzata Nita, who is conducting the palynological analyses of the collected series of deposits.

In terms of the paleobotanical analysis, in 2014 together with Prof. Małgorzata Nita I started studies on the next three sites in the river basin of the Brynica. These are two fossil peatbogs "Żyglin" and "Bizja", as well as one still functioning - the peatbog "Ossy". The aim of the research conducted by the analysis of macroscopic plant remains and pollen analysis is to trace the evolution of vegetation and environmental changes occurring in the Holocene

within the upper part of the river basin of the Brynica (Silesian Upland). All sites are of low thickness of organic deposits (up to 145 cm). They consist mainly of fairly well decomposed sedge peat, sometimes of the varying degrees gritty and at places with a significant amount of wood, mainly of *Alnus glutinosa*. Based on previous pollen analyses it can be said that the series of sediments were accumulated from at least the Boreal. They are not complete though and contain gaps. In the youngest sediments of the Bizja site fairly numerous traces of human activity are preserved in the form of pollen grains of e.g. *Triticum* and *Secale cereale*. The macroremain communities at all sites were most strongly represented by the rush taxa and those connected with the rushes communities. In some levels, especially in the sites of Bizja and Żyglin, also trees were well represented, mainly *Alnus glutinosa* and *Betula pendula*. In all the sites I found the presence of levels of significant participation, or the domination, of brown moss (mainly *Drepanocladus*) or peat-moss. The macroremain analysis I conducted indicates several stages of development of the peatbogs. However, the dominance of remains representing rush vegetation and the nature of sediments indicate that different types of rushes played a decisive role in their development at most stages. The presence of charcoal in all the studied sediment profiles also shows several fire episodes. Details of the preliminary results of these studies were presented at the conference ($K.25_1$ and A.13 - Annex 5) and are currently being prepared for publication.

I also used the plant macroremain analysis to study the site "Rotuz", which is located in the Upper Vistula Valley on the local watershed between the Vistula River Valley and the Iłownica Valley. My goal was to reconstruct the evolution of peatbog vegetation, presently protected in a reserve, and trace changes of the surrounding environment. The results of the macroremain analyses were confronted with those of the palynological analysis made by Prof. Margaret Nita. This made it possible to characterise the vegetation changes, both locally and regionally. Paleobotanical sediment analyses confirmed that the origins of the functioning of the Rotuz peatbog fell on the Younger Holocene (4200±190 BP). They also showed its terrestrial origins and lack of limnic phases of development. Since its beginning, the peatbog was formed of mainly *Sphagnum magellanicum*, constantly present in the phytocoenoses. Changes in vegetation resulted mainly from the changing participation of trees in the phytocoenoses (*Picea abies*, *Betula* sect. Albae, *Pinus sylvestris*), and the species such as *Eriophorum vaginatum*, *Scheuzeria palustris* and *Sphagnum fallax*. The most important of these changes occurred in the initial period and were associated with a fire episode, which caused a temporary increase in the trophy of the habitats and brought changes in hydrological

conditions. Details of the preliminary results of the paleobotanical analysis of this site were presented in the paper on the contemporary vegetation and habitat conditions of the peatbog. This article will also be published in the journal "Fragmenta Floristic et Geobotanica" (Annex. 3b).

In 2011 I collaborated in the preparation of the interpretation of the plant macroremain analyses conducted by Dr. Anna Hrynowiecka for the site in Nowiny Żukowskie in the Lublin Upland, an important site for the stratigraphy of the Polish Pleistocene of the Mazovian (Holsteinian) Interglacial. The aim of this project was the reconstruction of the history of vegetation and changes in the environment in the surroundings of this site. The result of this collaboration was the joint publication, which presented the detailed results of the study (Hrynowiecka & Szymczyk 2011).

Starting the research of the sites of the Holocene sediments I also became interested in the interpretive potential of the macroremain analysis. In particular, I was interested in the extent to which macroremain communities may reflect the actual state of the parent vegetation. When analysing the literature, I noticed that this problem was considered only in a few papers in relation to selected groups of plants (Birks 1973, Davis 1985, Zhao et al. 2006, Koff & Vandel 2008, Wainman & Mathewes 1990). During a conversation about my plans, Prof. Kazimierz Tobolski drew my attention to the problem of quantitative aspects of the plant macroremain analyses. Suggestions and guidance of Prof. Tobolski encouraged me to take up the issues of taphonomy of plant macroremains and spurred the beginning of the studies of modern sediments. After the adoption of relevant criteria, I selected several anthropogenic water reservoirs, already known to me from the earlier studies. In 2006, simultaneously with the research on older Holocene sites, I began preparation for the research of the top sediments of the first of them, a small reservoir in Sławków. As a result, I indicated, among other things, that the best represented in the macroremain communities were rushes (68.8% of the species); aquatic species were slightly less often (60%); and the least often were trees and shrubs (28.6%). Species composition of the phytocoenoses operating in the reservoir and in its immediate surroundings were best reflected by the macroremain communities from the area adjacent to the belt of rushes. I also showed that for such species as *Mentha aquatic* and *Hippuris vulgaris*, as well as genus *Carex* the number of diaspores well reflected their modern participation in the phytocoenoses. The number of the seed of *Schoenoplectus tabernaemontana*, *Ranunculus lingua*, *Menyanthes trifoliata* and *Lycopus europaeus* fairly well corresponded with their representation in modern rushes. *Chara* sp., *Juncus inflexus* and

*Eupatorium cannabinum* were overrepresented, while *Epilobium hirsutum* and *Rumex hydrolapathum* were slightly overrepresented. *Typha latifolia* and *Sparganium minimum* were poorly represented in relation to the contemporary coverage. Carpological remains of the reed, dominant in the modern-day rushes, failed even as an indicator of the presence of this species. What I found is that in many cases single seeds (*Potentilla erecta*, *Myosotis scorpioides*, *Lythrum salicaria*, *Scutellaria galericulata*), or just their increased concentration (*Hippuris vulgaris*, *Mentha Aquatica*, *Schoenoplectus tabernaemontana* and *Chara* sp.) reflect well the contemporary location of patches of native vegetation. The study also revealed that among the many factors influencing the distribution of diaspores in the studied reservoir, of crucial importance - besides the shape of its basin - is the distribution of vegetation patches. I have also indicated that a wide belt of rushes can act as a buffer limiting the migration of seeds from outside the reservoir and may trap them in the marginal parts of the basin. The detailed results of the research was presented in the publication (Szymczyk 2012) which appeared in the magazine from the JCR list (Journal of Paleolimnology). The achieved results of the study encouraged me to expand and continue the research in other reservoirs, the results of which were presented in a monographic study (Szymczyk 2015) declared as the thesis giving rise to the initiation of habilitation.

In 2012, in cooperation with the palynologists from the Department of Biogeography and Paleoecology of the Adam Mickiewicz University in Poznań and the transfer of the samples of sediment from the reservoir at Sławków for further analysis, we managed to find coenobia of the *Pediastrum argentinense*-type of unknown taxonomic position. This has resulted in preparation of a publication with an international team (Lenarczyk et al. 2015), which I co-authored, and which focuses on the morphological variability of the *Pediastrum argentinense*-type, its occurrence in the sediments of the Late Glacial and Holocene in Central Europe, as well as the diagnostic value of this taxon for the paleolimnological research.

During the research on the factors determining the distribution and abundance of carpological plant remains in lake sediments, I became interested in the phenomenon of the formation of algal mats built mainly by diatoms and filamentous algae, which I observed quite often. Further observations at different reservoirs indicated that algal mats that formed periodically on the surface of the sediment and drifted later on the surface, can participate in the transportation or even redeposition of sediments, including plant remains, and thus affect the distribution and abundance of plant remains in lake sediments and consequently the formation of taphocoenoses. The study of algal mats has been discussed in a number of

publications relating to their formation and many aspects of the operation. What was analysed, among others, are the conditions in which they form (Wetzel 1996), their functioning in the ecosystem (Berry & Lembi 2000) and, above all, their importance for the stability and the prevention of resuspension of lake sediments (Widdows et al. 2004), as well as the phosphorus, nitrogen and carbon cycles (McDougal et al. 1997). However, the role of the algae mats in the movement of sediments and dispersal of diaspores and plant remains within the basin of the reservoir, and thus their influence on the formation of taphocoenoses, had not been addressed yet. I decided to check these theses, and in 2012 I began studies in the reservoir, in which I found the formation of two types of algae mats: built mainly by filamentous algae or built by diatoms. In addition to checking the set theses, I also tried to assess the scale of the transportation in relation to particular ecological groups of plants growing in the reservoir and its immediate surroundings. These studies confirmed that the algal mats are involved in the transport of diaspores and plant remains. I also showed that the mats built by filamentous algae are involved primarily in the primary transport of diaspores and can cause their concentration and movement mainly between the shores of the reservoir. Diatomaceous mats, on the other hand, are involved primarily in redeposition of diaspores and plant remains, and can cause their scattering and migration between the coastal zone and the central parts of the reservoir. I also found that much more remains - and of more diverse species - are associated with mats built mainly by diatoms. I suggested that because the scale of the phenomenon of the transportation of the carpological remains with the participation of both types of algae mats indicates their important role in the formation of taphocoenoses, thus the possibility of their appearance should be taken into account in interpreting the macroremain analyses. I also pointed to the diagnostic features of the paleoreservoirs, where the participation of algal mats in the formation of taphocoenoses should be taken into account. The initial, partial results of these studies were published as early as 2014 (Szymczyk 2014), and in 2016 the article summarising the whole study was published in the "Journal of Paleolimnology". This paper and the article on the reservoir at Sławków (Szymczyk 2016) present the results of research following up the issues raised in the thesis presented as an achievement forming the basis for initiating a habilitation.

In 2013, together with Prof. Monika Barańska, I undertook the study which aimed at, among other things, an attempt to verify the possibility of using deposits of peatbogs as archives that store a record of changes of environmental pollution with compounds originating from the combustion of fossil fuels. The research were carried out on six peatbogs

of southern Poland, from which samples of peats of different botanical composition were collected. The study focused primarily on the search for geochemical markers of pollutants from the combustion of fossil fuels. We have shown, among other things, that peat is a promising archive not only for biomarkers of fuel burned and transported to the peatbogs along with volatile dust, but also of polycyclic aromatic hydrocarbons and heavy metals. We have also pointed out that the best for this type of research are peatbogs which deposited the peat built mainly by *Sphagnum* sp. or those with its predominant participation due to its high sorption properties. The detailed research results were presented at an international conference (K.9 and A.11 - Annex 5) and were published in the journal "Chemie der Erde – Geochemistry" (Fabiańska et al. 2013).

The adoption of the issues related to the application of geochemical methods in the study of organic deposits also resulted in the cooperation with the Institute of Bio- and Geosciences in Jülich (Germany) in the implementation of the project carried out there on creating a database of geochemical markers of different types of wood that can be used in qualitative and quantitative research of its presence. In this study, using the Curie-Point pyrolysis GC/MS method (gas chromatography coupled with mass spectrophotometry) we analysed several samples of bog-wood of different botanical composition and levels of decomposition from several peatbogs of southern Poland, for the collection, selection and designation of botanical composition for which I was responsible. The results of these studies were published in 2015 in the framework of an international conference of the 27th International Meeting on Organic Geochemistry in Prague (K.11 and A.15 - Annex 5). The publication presenting the results of the studies conducted so far is being prepared.

I carried out the studies of biocenoses forming spontaneously within the disused sandpit workings of the eastern part of the Silesian Upland, mostly with a team of workers of the Department of Physical Geography, Faculty of Earth Sciences, University of Silesia. Occasionally, when determining rare species of bryophytes, I cooperated with Dr. Adam Stebl from the Department of Pharmaceutical Botany and Herbology of the Silesian Medical University (Szymczyk et al. 2003). These studies focused mainly on assessing the function of the excavation as anthropogenic substitute habitat for populations of rare and protected species of plants and animals. Their aim was also to draw attention to the importance of the disused sandpits for the species primarily associated with the early stages of succession and identify methods for their protection. The results of these studies were presented at conferences (K.4, K.18, K.19, K.20 i A.1, A.2 - Annex 5) and discussed in several Polish

(Szymczyk et al. 2003, Szymczyk et al. 2011) and English articles (Czylok at al. 2008, Rahmonov & Szymczyk 2010) published in national and international journals contained in part B of the list of the Ministry of Science and Higher Education; additionally, one article was turned into as a chapter in a monograph in English (Czylok & Szymczyk 2009). The results of the studies on species diversity of phytocoenoses and rare species in the early stages of succession in the excavations presented in the individual papers have shown that the highly deformed areas may provide replacement habitats for many plant species threatened with extinction. The phytocoenoses of initial stages of succession forming in the flooded and waterlogged excavation bottoms, in particular communities of seepage marshes dominated by *Equisetum variegatum*, create conditions to maintain relatively large populations of many unique plant species. The conclusion of our research in the sandpit of Kuźnica Warężyńska, where the bottom area subject to spontaneous regeneration is the largest, and the forming ecosystems offer habitats to especially abundant populations of species such as *Liparis loeselii*, *Epipactis palustris*, *Malaxis monophyllos*, *Drosera rotundifolia*, *Pinguicula vulgaris*, *Lycopodiella inundata* and others, was a proposal of the inclusion of the most valuable fragments of the disused sandpits to the program of the protection of rare and endangered species under the Special Area of Conservation Natura 2000. The proposal went through execution in 2011 when the area was included in the Special Area of Conservation (SAC) "Lipienniki in Dąbrowa Górnicza" PLH240037.

Parallel to the study of the flora and vegetation appearing in the disused sandpit workings, the interest of our team was a continuation of the succession directions and the relationship between the habitat determinants and encroaching vegetation and forming soil cover, i.e. the issues already discussed in my doctoral dissertation. As a result of the research and observations we found, among other things, that the most important factors determining the characteristics of the habitat, species composition of the emerging phytocoenoses, the course of succession and finally the properties of the forming soils are the depth of the water table and the ascending groundwater. The various aspects of this research were described in the articles (Szymczyk 1999a, Rahmonov & Szymczyk 2010, 2011), including those published in the journals on the list of the Ministry of Science and Higher Education.

The research I conducted in the sandpits also proved that not only damp and waterloggesd bottoms of sandpits are the places where the ecosystems which are valuable from the point of view biocoenotics develop. I have shown that as a result of natural morphogenetic processes and spontaneous vegetation succession anthropogenic watercourses,

old drainage canals and zones of water outflows become similar to natural springs and streams typical for e.g. Kraków-Częstochowa Upland. Similarly to the Prądnik and Sąspówka, the sandpit "Siemonia" was dominated by the associations of the *Sparganio-Glycerion fluitantis*, often including communities of *Glycerietum plicatae* and *Nasturtietum officinalis*. In the outflow zones in the sandpit I also found, among other things, calciphilous communities of *Cratoneuron filicinum*, sites of *Helodium blandowii* regarded as a glacial relic, and several species of legally protected vascular plants. Detailed results of these studies have already been published (Szymczyk & Rahmonov 2010).

The subject of wider changes in the environment due to anthropopressure and nature conservation was another stream of research conducted in the years 1998 - 2015 within the statutory research. I conducted these studies either in a team or on my own. Their effect were 18 published papers (Annex 3a), which I authored or co-authored. 10 of them were published in the journals from the list of the Ministry of Science and Higher Education. The results were also presented at national and international (Annex 5) conferences. These studies concerned in particular the formation of ecological systems in sedimentation tanks of coal mines, in which we pointed out the negative and positive aspects of the presence of such tanks in the environment (Rahmonov et al. 2010, 2012). The studies also related to the functioning of ecosystems within reservoirs formed in the subsidence basins in the area of Bytom, and their importance for biodiversity conservation. As a result of these studies I pointed to the particular importance of these reservoirs for the preservation and protection of bird populations (Szymczyk 2013), or microthermic conditions of the occurrence of the sites of mountain plant species in the valley of the White Przemsza (Salasa-Orpych & Szymczyk 2007). The ongoing research also included the issues of the widely understood landscape transformations occurring due to human activity (Banaszek & Szymczyk 2014). In this respect, I also participated in the studies taking up the issue of degradation of forest ecosystems in the area of the Silesian Beskid in the last 170 years (Karkosz et al. 2014). In 2012 and 2013 I took part in the international project conducted by Prof. Oimahmad Rahmonov on a strategy to protect biodiversity at the level of species and landscape diversity of the Fann Mountains in north-western Tajikistan. The results of the work carried out within the framework of this project were presented at the 16th International Symposium on Problems of Landscape Ecological Research in Smolenice, Slovakia, and were published in 2013 (Rahmonov et al. 2013).

Some projects in the field of formation and transformation of the environment were of practical nature and their result, besides conference presentations (Annex 5), including those commissioned (K.17 and A.9 - Annex 5), were quite numerous studies, which I am a co-author or author of (Annex 4). The most important of these include, among others, the preparation of a study of the social and environmental impact of the closure of the mine ZGH Boleslaw SA by the flooding, which I conducted in cooperation with the employees of the Academy of Mining and Metallurgy in Krakow. It included the following tasks: (1) forecasting the impact of mining activities on the environment, (2) expected impact of mining on the surface throughout the entire period of the mine operating, (3) environmental identification within the entire cone of depression (E.9 - Annex 4).

I was able to use the experience and knowledge gained during the studies conducted so far to help develop the concept and implement the research within the framework of the doctoral dissertation "Ecopedological effects of land use in the area of the Silesian Beskid" by Dominik Karkosz under the supervision of Prof. Oimahamad Rahmonov, of which I am an auxiliary promoter since 2012 by the decision of the Board of the Faculty of Earth Sciences, University of Silesia. The doctoral proceedings have already started and the doctoral thesis is expected to be finished this year.

The studies on nature conservation which I conducted were mostly practical. They included an inventory and assessment of the current state of the environment for the need of nature protection, the creation of zoning plans or investments. Thus, besides the publication in journals (Czylok at al. 2004, Czylok & Szymczyk 2009, 2012, Salas-Orpych & Szymczyk 2007, Szymczyk 1999, 2004, 2013, Szymczyk et al. 2003, 2004, 2011), and conference presentations (Annex 4), their further effect were primarily unpublished studies of an implementation character (Annex 4). In this respect, I also participated in the research aimed at developing the concept of protection of populations of species or habitats. The most interesting of this kind of research included the one on saving the endangered population of bitterling *Rhodeus sericeus*, which led to the establishment of practical principles of its active protection (Czylok & Szymczyk 2004); developing the concept of protection of natural and landscape values of the Rzędkowickie Rocks in the Landscape Park of Eagles' Nests (Szymczyk et al. 2004); assessment of the directions of natural succession in the area of the Landscape Park "Forests of the Upper Liswarta" (Czylok et al. 2004), and the inventory and natural valorisation of the areas located in the administrative boundaries of Gmina Wojkowice (E. 16 - Annex 4).

Long-term research cooperation in the natural parks in the Śląskie Voivodeship and my experience in the work on the functioning of hydrogenic ecosystems were used in the context of team work for the protection of wetlands appointed by the Board of the Landscape Park "Forests of the Upper Liswarta", which I became a member of. In addition, I was also a member of the Polish Association for Landscape Ecology and I am a member of the Polish Geographical Society.

After obtaining a doctoral degree I reviewed a dozen studies published in collective works and journals, both national and international. These were impact factor journals: "*Quaternary International*" and "*Polish Journal of Environmental Studies*" as well as "*Acta Geographica Silesiana*", "*Contemporary Trends in Geoscience*" (journals of the Part B of the list of the Ministry of Science and Higher Education); "*Research on the impact of anthropopressure on the environment*" (cyclical publication) and "*Contemporary Treds in the Earth Sciences*" (collective work) (see Annex 4). I am also the author of the reviews of the the monographic publication "*Peatbog Żabieniec: natural conditions, development and record of paleoecological changes in its sediments*" (Szymczyk 2012).

My participation in the organisation work at the university was based on participation (as a member) in the Faculty Admissions Committee at the full-time first degree programmes - Geography speciality (2007 - 2009). I also participated in the organisation of the Limnological Conference "Lakes and artificial water reservoirs – operation, revitalisation and protection", Sosnowiec, 15-17 September, 2004 as a co-organiser of field sessions; I also helped in the organisation of "II Forum of Polish Geographers", Sosnowiec, 14-15 March, 2005. I was involved in organising and conducting field trips for school children as part of "The Earth Day" (22 April 2004).

My teaching activities at the university after obtaining a doctoral degree included conducting classes for intramural and extramural programs. These were lectures, including optional ones, and those within the specialisation subjects, laboratory classes in 13, field work, including these part of Master's course, Bachelor's workshops and seminars as well as Master's workshops. Within the framework of teaching, I was a reviewer of over 100 theses and promoted 30 BSc theses (details in Annex 4). I developed the original course programs: "Biological Content in teaching Science" – workshops, and lectures within a block of "Aquatic ecosystems of Silesia" - optional lecture. I am also a co-author of the programs of several other subjects, including "Fundamentals of environmental management and protection" – workshops, "Anthropogenic ecosystems" – specialisation subject, "Nature

regeneration in deformed areas" – specialisation subject, and "Protection of natural and cultural resources in spatial planning" – specialisation subject.

My activities of popularising science include two years of organising and conducting numerous activities and field trips with school students in the International Environmental Education Centre in Rogoźnik; publishing 11 articles (Annex 4) on the issues of animal synanthropisation and approximating the ecology of selected species in the monthly "Zielona Liga" which popularises knowledge about nature, the environment and environmental education; publishing a chapter in a collective work concerning fauna of the Wodąca Valley near Smoleń. (Szymczyk 1998).

In cooperation with the social and economic environment I carried out or was a co-author 20 of the expertises or studies on the request of public institutions or companies (Annex 4). In the years 2012 and 2013 I was also a member of two projects co-financed by the European Union and implemented in collaboration with the University of Silesia. They were: in 2012 the "Internship Scientist's Success" implemented by the Poznań Academic Business Incubator (Contract No. 1-I/SSNK/2012), and in 2013 "ekoStaż" implemented by the Regional Chamber of Commerce in Katowice (contract NrEKOSTAŻ/5/2013). Their main objective was to promote cooperation between the academic sectors and businesses in the context of raising the level of innovation and competitiveness. The subject of internships carried out jointly with the company "Aerdo Group" was to develop the concept and content as well as to cooperate in the implementation of automatic system of nature identification (SAIP) using QR codes and mobile technologies. Implementation works and improvement of the system in the parks in Świętochłowice and Tarnowskie Góry continued in 2013 under the project "EkoStaż.

## 6. Summary of scientific achievements

The total *impact factor* of my publications published after the doctorate, according to the list of the Journal Citation Reports (JCR), according to the year of publication, is 9.001. The number of points of the Ministry of Science and Higher Education obtaines for all the publications is 253 (251 post-doctoral, 2 pre-doctoral).

The total number of citations by database:
**Web of Science** (as of 26 April 2016) is; 21 Hirsch index: 3

http://apps.webofknowledge.com/CitationReport.do?product=UA&search_mode=CitationReport&SID=R1K5eECLsSwjPLU7c3r&page=1&cr_pqid=10&viewType=summary

**Scopus Database** (as of 26 April 2016) is 18; Hirsch index: 3

https://www.scopus.com/cto2/main.uri?origin=AuthorProfile&stateKey=CTOF_677854476&CTO_ID=CTODS_677854467&hIndex=3&docCount=9&hType=author&groupedAuthor=false

According to the statement of citations prepared by the Main Library of the University of Silesia on the basis of the databases of the Web of Science™ Core Collection and Scopus Databese - Annex 6), these indicators are:

**Web of Science** (as of 13 April 2016) is 27; Hirsch index: 3

**Scopus Database** (as of 13 April 2016) is 34; Hirsch index: 3

I am the author or co-author of 28 original research articles published mostly in English in national and international journals (Annex 3b). Five of them were published in the journals indexed in the database of the Journal Citation Reports (I am the author of two and co-author of three of them), and 17 in the journals contained in Part B of the list of the Ministry of Science and Higher Education. All publications from the JCR list and Part B of the list of the Ministry of Sciene and Higher Education were published after obtaining the doctoral degree. I am also the author 1 monograph, co-author of two chapters in collective monographic studies, 1 popular science monograph and chapter in collective popular science publications (list of publications attached). The results of my research were presented at 11 international conferences (3 presentations and 8 poster presentations), and 14 national conferences (6 presentations and 9 poster presentations). I am also the author or co-author of 15 abstracts. Most of the conferences took place after my obtaining the doctoral degree.

After obtaining the doctoral degree I reviewed several articles published in collective publications and journals, both national and international, including those with the impact factor ("*Quaternary International*" and "*Polish Journal of Environmental Studies*") (Annex 5).

In my research I worked and cooperated with a number of specialists from national centers (e.g. Department of Biogeography and Paleoecology of the Adam Mickiewicz University in Poznań, AGH in Kraków, Department of Pharmaceutical Botany and Herbology Medical of the University of Silesia), and the centres outside Poland (e.g. Institute of Bio- and Geosciences in Jülich in Germany). I am also a member of the Polish Geographical Society. I participated in few programs of statutory research carried out at the Department of Earth

Sciences, and twice guided the own research program. I helped in the organising two Conferences, I organised and conducted field trips for school children as part of "The Earth Day" and – as a member – I took part in the works of the Faculty Recruitment Commission for full-time first degree studies (2007-2009) (Annex 4).

As part of the teaching duties I have conducted classes for intramural and extramural programs in 13 subjects. I was a reviewer of over 100 Master theses and I promoted 30 Bachelors (details in Annex 4). I was the author or co-author of (6) course programms. I am also an auxiliary promoter of the doctoral procedure of Dominik Karkosz, MSc, titled "Ecopedological effects of land use in the Silesian Beskid."

In cooperation with the social and economic environment (Annex 4) I have carried out or been co-author of (20) expertises and studies. In the years 2012-2013 I was also a member of two projects co-financed by the European Union and implemented by the Poznań Academic Business Incubator and the Regional Chamber of Commerce in Katowice, in collaboration with the University of Silesia ("Internship Scientist's Success" and "ekoStaż"). Their goal was to promote cooperation between the sectors of science and business in the context of raising the level of innovation and competitiveness.

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