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**Biological research of Grabia River
– fifty years of activity**

Abstract: Grabia, a small still close to natural conditions lowland river, has been an object of special interest for Łódź hydrobiologists for more than 50 years. Over 100 scientific papers and over 100 master theses were produced in the Faculty of Biology and Environmental Protection University of Łódź. The initiator was Prof. L. K. Pawłowski who spent many years conducting research into the river. The ground and the first research objective was to recognize the fauna diversity. The checklist encompass almost 1000 invertebrate and 24 fish species. Taxonomy, biology and ecology of various taxa have made for many decades an essential trend of scientific activity. Special attention was dedicated to rotifers, leeches, branchiobdellids, snails and bivalves, gammarids and copepods as well as aquatic insects, fish and also diatoms. Some aspects of zoobenthos and zooplankton communities ecology was the subject of 13 Ph. D. theses. The river with its rich animal and plant communities was also the subject of dynamics of river ecosystem research. The study on the structure of invertebrate assemblages on the background of habitat diversity has been recently conducted. The model may be treated as a reference to the restoration of European rivers and their valleys.

Key words: lowland river, ecology, central Poland, literature review.

1. Introduction

The Grabia River has been an object of special interest to Łódź hydrobiologists for more than fifty years. This small, typical rustic lowland river with an agricultural forested drainage basin is still close to natural conditions. This article is a synthetic presentation concerning the scientific results of biological research on the river. It also serves as an expanded and more detailed version, containing references to existing scientific literature, of the lecture presentation given in connection with the centenary

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anniversary celebration of the birth of Professor Leszek Kazimierz Pawłowski (PIECHOCKI 2002), who initiated and spent many years conducting research into the river. This anniversary celebration took place on December 19, 2002 in connection with the naming of a lecture hall in the Department of Biology and Environmental Protection in Professor Pawłowski's honor.

2. Study area

Grabia, a right bank tributary of the Widawka, is a river of 81 kilometers in length forming part of the Oder river basin (Fig. 1). The drainage area of the river covers 820 square kilometers. The river's water sources lie 229 meters above sea level and exude an average of 0,2 liters of water per second. The average depth of the river ranges from 0,5 meter in its upper stream to 0,8 meter in the lower, at times exceeding 2 meters in depth in its deepest parts. At the upper course the river bottom is sandy and sand-gravelly, changing to sandy and sandy-muddy in its middle course, with a muddy sandy bottom in the lower course. The width of the river valley ranges from 100 meters in the upper range to 1000–2000 meters in the lower. The Grabia empties into the Widawka at 143 meters above sea level, with an average slope of 1,06%. A description of the detailed physiographic characteristics of the Grabia River basin, including climatic conditions, sculpture of the earth's surface, the geology and the hydrography and flora profile can be found in the papers of PAWŁOWSKI (1958) and MAKSYMIOUK (1970). The waters of Grabia River are assessed as clean and its self-purification capacity is assessed as high (BABSKI et al. 1985). An excess of nutrients flowing into the river has been sometimes noted, especially in the upper course. Biological analyses of the fauna variation in the Grabia have been carried out for many years by employees of the University of Łódź and have demonstrated the high quality of its waters, which encourage the development of rich and diversified fauna and flora assemblages. This is confirmed by the high diversity of water insects inhabiting the river, in particular by stoneflies (Plecoptera) and mayflies (Ephemeroptera), which are considered to be among the best biological indicators of clean water.

The river valley in its middle and lower ranges is full of picturesque old riverbeds in various stages of succession. The bewitching aura of the river and river valley, the rich and variegated history of the area (DRONKA, ZIARNIK 1995), the many years of research conducted into its flora and fauna, and its value as an object of hydrobiological research all combined to spawn the idea of turning the river into a protected nature reserve

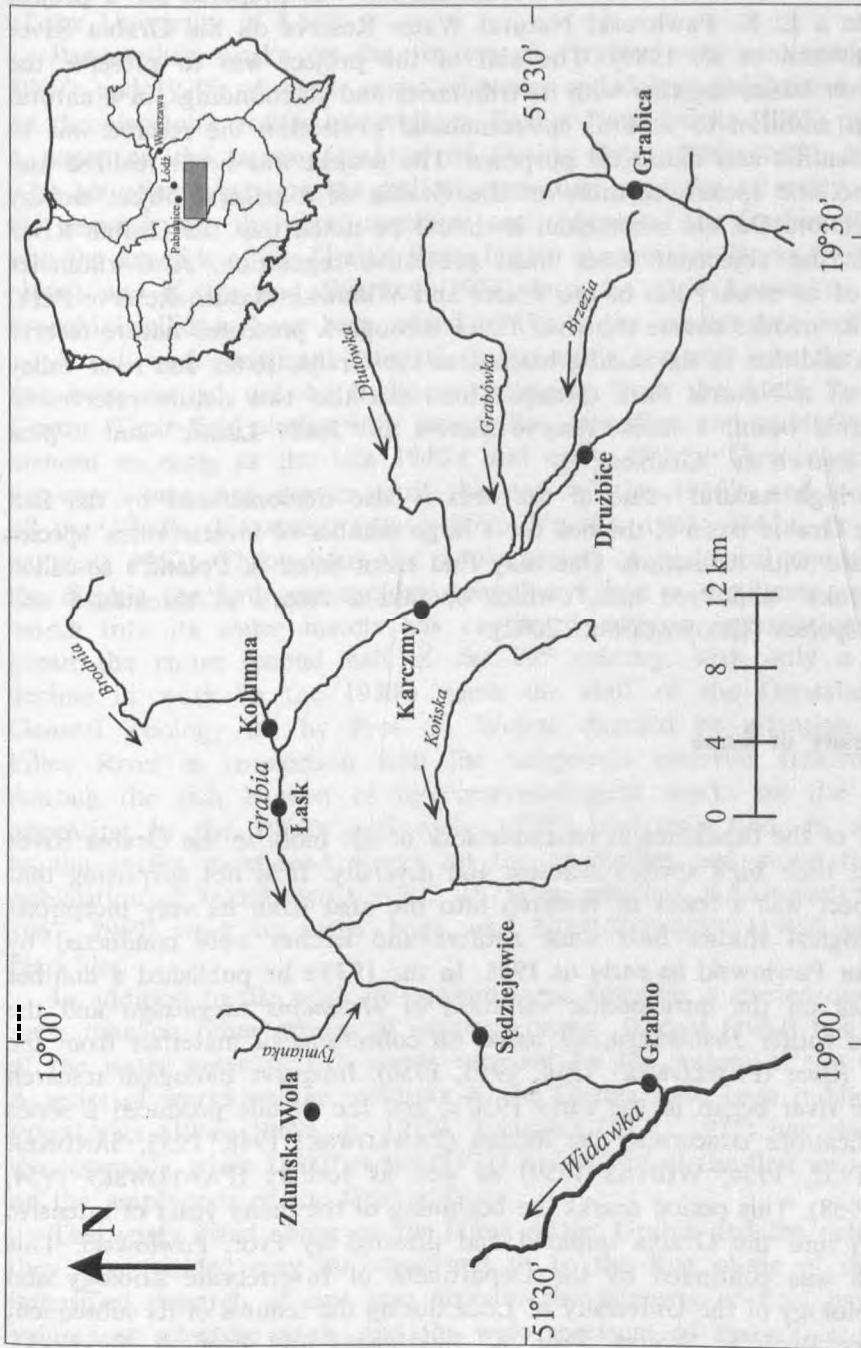


Fig. 1. The Grabia River and its location in Poland

(SICIŃSKI 1985). In the 1980' s documentation was prepared for a project to create a L. K. Pawłowski Natural Water Reserve on the Grabia River (JAŻDŻEWSKA et al. 1989). The aim of the project was to preserve the small river basin, together with its tributaries and surroundings, in a natural state. In addition to natural environmental protection the reserve was to serve scientific and didactical purposes. The project was never realized and today no one speaks anymore of the Grabia as a natural object worthy of protection. On the other hand it should be noted that the Grabia River valley is the object of lesser local protective regulation. A 6 kilometer stretch of its estuary lies in the Warta and Widawka Nature Reserve Park, and in its middle course the river flows through a protected nature reserve area. In addition in the middle basin area the Grabia River and river valley is part of a Natural Park Group. There are also two nature reserves in the Grabia basin: a forest reserve known as "Jodły Łaskie" and a peat reserve known as "Grabica."

The high natural value of the area is also demonstrated by the fact that the Grabia basin is the bed for a large number of invertebrates' species threatened with extinction. One may find them listed in Poland's so-called "red books" and "red lists," which contain a record of threatened and extinct species (GŁOWACIŃSKI 2002).

3. Diversity of fauna

One of the fundamental characteristics of the biota in the Grabia River valley is their high species richness and diversity. It is not surprising that this aspect was a focus of research into the area from its very inception.

Biological studies into some rotifers and leeches were conducted by Professor Pawłowski as early as 1928. In the 1930's he published a number of works on the intraspecific variation of *Haemopsis sanguisuga* and the parasitic rotifer *Drilophaga*, all based on collections of materials from the Grabia River (PAWŁOWSKI 1934, 1935, 1936). Intensive biological research into the river began in the early 1950's, and the decade produced a series of publications concerning the leeches (PAWŁOWSKI 1948, 1955; SANDNER 1951, 1952, 1954; WOJTAS 1959) as well as rotifers (PAWŁOWSKI 1954, 1956, 1958). This period marks the beginning of the many years of intensive research into the Grabia initiated and directed by Prof. Pawłowski. This research was continued by the Department of Invertebrate Zoology and Hydrobiology of the University of Łódź during the tenures of its subsequent directors: Prof. F. Wojtas, Prof. K. Jażdżewski and Prof. A. Piechocki. Over time the Grabia became an object of biological and ecological

research among various units of the Faculty of Biology and Earth Sciences of the University of Łódź.

Pawłowski's works on the rotifers of Grabia were continued in the 1960's and 1970's. A cyclic series of works ended in a publication in 1980 on the pleustonic rotifer assemblages. Earlier PAWŁOWSKI (1969) published a paper on the potamoplankton of Grabia River. This work, alongside with his other works on the rotifers, constitute examples of rarely conducted research into the micro-organism assemblages of the Grabia. Research into the annelids of the Grabia River is also continuing. Works by WOJTAS (1964) and KAHL and WOJTAS (1974) into the little known in Poland branchiobdellidans have been added to the earlier studies into leeches.

A rich and significant part of the scientific research into the Grabia has been carried out by hydroentomologists from the Łódź Zoological Centre. Their field studies into dragonflies, stoneflies and caddisflies commenced as early as the late 1940's and early 1950's. Their conclusions, however, were not drawn until the end of the 1950's and beginning of the 1960's (KLIMASZEWSKA 1959; WOJTAS 1961, 1962a, b; TOMASZEWSKI 1962). Throughout the whole period of biological research into the Grabia the hydroentomology has always had a significant role. Research into its water insects has continued without interruption throughout the entire second half of the 20th century, with only a certain decline in work in the 1970's when the staff of the Department of General Zoology led by Prof. F. Wojtas directed its attention to the Pilica River in connection with the Sulejowski reservoir created there. Among the rich harvest of hydroentomological works on the Grabia appearing in the 1960's and early 1970's one may find, in addition to the earlier mentioned works on the caddisflies and stone flies, the publication of JAŹDŹEWSKA (1967, 1971) on mayflies, KRAJEWSKI'S (1966, 1967, 1969) work on water bugs, and NIESIOŁOWSKI'S (1969) work on blackflies.

In addition to the work on entomofauna, research is carried out at the same time on other groups of invertebrates. BAZAN (1962) has written of the water mites of fish ponds supplied by the waters of the Grabia. A series of works on the mollusks of the Grabia have been published by PIECHOCKI (1966, 1969a, b, 1975). TABACKI (1971, 1977) has elaborated the copepods, while JAŹDŹEWSKI (1977) has published the first information on the amphipods of the Grabia River.

The works listed above on the fauna of the Grabia and the rich results they have yielded may be considered to be the first phase of the most intensified research, if one into account the intensity of field work, the volume of scientific work, and the wide spectrum of taxon's into which research was conducted. The basic composition of species and the distribution

of hydrofauna were then identified. So, the groundwork was laid for the implementation of further projects.

Publications concerning the invertebrates of the Grabia have appeared largely without interruption throughout the past half century. In the 1980's research into dragonflies was re-initiated and research into the mayflies was continued (JAŹDŹEWSKA 1997, 2001; TOŃCZYK 2001 – Ph D Th.). Particularly research into the non-biting midges, a group which play a key role in the benthos fresh water biota, was intensified. An expression of this trend in chironomid fauna research can be found in the series of works by GRZYBKOWSKA (1989, 1991, 1993 – Ass-Prof. Th.; GRZYBKOWSKA, WITCZAK 1990; GRZYBKOWSKA et al. 1990, 1996) concerning various aspects of the biology and ecology of Chironomidae. Research into this group of true flies is continuing. Non-biting midges and blackflies are not the only Diptera which have captured the attention of Łódź entomologists. WIEDEŃSKA (1987) has studied the crane flies (Limoniidae). The 1990's produced further interesting data and materials concerning the crustacean fauna inhabiting the underground waters of the Grabia River valley (KONOPACKA, SOBOCIŃSKA 1992).

Research into the fauna of the Grabia River has of course by no means ignored its fish. In a series of works into the ichthiofauna of the rivers of the Łódź Upland Region PENCZAK (1963 and 1969a, b, c) conducted a review of the species of the Grabia River as well as of their ecological characteristics. Research was conducted into other biological and ecological aspects of fish in the 1980's and 1990's (BAŃBURA et al. 1985; NOWAK, ZALEWSKI 1991). It should be noted, however, that the earliest information about the fish of the Grabia come from KULMATYCKI (1936). Other vertebrates of the Grabia region have not been the object of much scientific interest. KOEPPEN (1943) did note the appearance of the pond tortoise (*Emys orbicularis*) in the Grabia River valley. PAWŁOWSKI (1970a) listed the amphibians of the Grabia and the basins of the catchment area. MARKOWSKI (1981) provides information about the black stork appearing in the Grabia area.

Some groups of water invertebrates of the Grabia River have been the object of particular attention, especially because a group of assistants of Prof. Pawłowski's conducted research as a part of their doctor's theses. Such detailed studies are available concerning leeches (SANDNER 1950 – Ph D Th., WOJTAS 1960 – Ph D Th.), mayflies (JAŹDŹEWSKA 1968 – Ph D Th.), molluscs (PIECHOCKI 1968 – Ph D Th.), water bugs (KRAJEWSKI 1967 – Ph D Th.) and copepods (TABACKI 1969 – Ph D Th.). In addition biology and ecology of some invertebrate taxa were the subject of several doctoral theses carried out in the Faculty of Biology and Earth Sciences, such as NIESIOŁOWSKI'S (1978 – Ph D Th.) work on blackflies, TOŃCZYK'S

(2001 – Ph D Th.) study of dragonflies and WIEDEŃSKA'S (1983 – Ph D Th.) work on crane flies. Three doctor's theses concerning the structural groups of fish in the Grabia were written within the Department of Applied Ecology (FRANKIEWICZ 1989 – Ph D Th.; ŁAPIŃSKA 1996 – Ph D Th.; KRAUZE 2002 – Ph D Th.). Studies concerning diatoms assemblages from selected habitats of the Grabia River (SEKULSKA-NALEWAJKO 2001 Ph D Th.) and into the hydrographical characteristics of the Grabia basin (MAKSYMIOUK 1970) close the list of Ph. D. theses devoted to the area. It should be noted however that Prof. Pawłowski's own doctor's thesis in 1932 concerning the rotifer *Drilophaga delagei* was based on materials captured in the Grabia. Studies carried out in the 1980's into the non-biting midges of several lowland rivers of Central Poland, including among others the Grabia, formed the basis for GRZYBKOWSKA'S (1993 – Ass.-Prof. Th.) habilitation thesis.

Years of hydrobiological research into the Grabia River have produced a number of summations (PAWŁOWSKI 1970a; JAŹDŹEWSKA, JAŹDŹEWSKI 1985; TOŃCZYK 1995). One especially important related event among Łódź biologists was a conference organized in 1985 by the University of Łódź in cooperation with the Polish Fishermen's League devoted to the topic: "Protection and Management of Small Rivers" (ZALEWSKI 1985a). Included among the presentations given was a summary of the research of University of Łódź biologists, hydrologists, and chemists into the Grabia River.

The almost one thousand species that have been recorded in the Grabia and its catchment area confirm broad scope of research conducted here over several decades. It also shows the richness of the hydrofauna of this water region. The reason for this is due to the natural or very close to natural characteristics of the river and its valley, which is particularly true of the numerous and varied primary type habitats. Until now, 979 species of hydrofauna (Tab. 1) have been identified in the Grabia and a new species of stonefly – *Isoperla pawlowskii* Wojtas, 1961 was described (WOJTAS 1961). Water insects form the best known group: stoneflies, mayflies, dragon flies, water bugs and blackflies as well as: mollusks, leeches and rotifers. In each of the above mentioned taxon the number of recognized species constitutes more than a half of all those described for Poland. This, in turn, reflects the intensity and thoroughness of the studies conducted. In groups with many species of mountain origin (stoneflies and mayflies) this percentage is lower and ranges from 25–30%.

Some taxa of water invertebrates require, however, further research. This is true of meio- and microzoobenthos: gastrotrichs, nematods, harpacticoids and some other groups like water fleas, caddisflies, water beetles, non-biting midges and other true flies. Still little is known about oligochaetes.

Table 1: The species richness of animal higher taxa from Grabia River

No	Taxon	Number of species	Author
1	Protozoa	21	PAWŁOWSKI (1958)
2	Porifera	5	PAWŁOWSKI (1970a)
3	Trematoda	28	PAWŁOWSKI (1958)
4	Rotatoria	276	PAWŁOWSKI (1956, 1958, 1960, 1968a, 1969, 1970b, 1971, 1973)
5	Gastrotricha	4	PAWŁOWSKI (1958)
6	Branchiobdellae	5	WOJTAS (1964)
7	Oligochaeta	18	KAHL (unpb. data)
8	Hirudinea	14	WOJTAS (1959)
9	Gastropoda	29	PIECHOCKI (1969b)
10	Bivalvia	21	PIECHOCKI (1969b)
11	Copepoda	33	TABACKI (1971)
12	Cladocera	25	PAWŁOWSKI (1958, 1968a, 1969)
13	Malacostraca	5	JAŻDŻEWSKI & KONOPACKA (1995)
14	Hydracarina	17	BAZAN (1962), STRYJECKI (unpub. data)
15	Plecoptera	9	WOJTAS (1962)
16	Ephemeroptera	39	JAŻDŻEWSKA (1971, 1997, 2001)
17	Odonata	52	KLIMASZEWSKA (1959), TOŃCZYK (1998, 2001 – Ph D Th.)
18	Heteroptera	50	KRAJEWSKI (1969)
19	Trichoptera	65	TOMASZEWSKI (1962)
20	Megaloptera	2	PAWŁOWSKI (1970a), TOŃCZYK (unpub. data)
21	Planipennia	2	TOŃCZYK (unpubl. data)
22	Coleoptera	63	PAWŁOWSKI (1970a), TOŃCZYK (unpub. data)
23	Simuliidae	14	NIESIOŁOWSKI (1980b)
24	Chironomidae	132	GRZYBKOWSKA (1989, 1993 – Ass.-Prof. Th.), KLUKOWSKA (1998 & unpub. data)
25	Limoniidae	15	WIEDEŃSKA (1983 – Ph D Th., 1987)
26	Cyclostomata	2	PENCZAK (1969a), MARSZAŁ (2000)
27	Pisces	24	PENCZAK (1969a)
28	Amphibia	9	PAWŁOWSKI (1970a)

The deep knowledge concerning the diversity of hydrofauna provides a basis for an analysis of the anthropogenic long-term impact of the river environment. Comparative studies of some taxa examined in 1950s and at present (KLIMASZEWSKA 1959 *versus* TOŃCZYK 2001 – Ph D Th.) indicate that the Grabia did not undergo significant changes and its fauna are highly stable in terms of their composition and structure. On the other hand, analysis of the water-course regulation in the context of hydrofauna assemblage shows unfavorable local changes resulting from hydrotechnical interventions (TOŃCZYK 2001 – Ph D Th.).

4. Didactic activity

Another subject worth considering is the importance of the Grabia River as an educational component of studies carried out by the Institute of Ecology and Environmental Protection. Problems tackled in various master's theses reflect, to a certain extent, the research directions followed by the scientists from the Department of Invertebrate Zoology and Hydrobiology since its inception and later conducted also in other Departments (Tab. 2). Two thirds of the Grabia-related master theses were written in the Department of Invertebrate Zoology and Hydrobiology (earlier, until 1985 known as the Department of General Zoology). Faunistically-oriented works concerning various taxa of water invertebrates of the river and its catchment area water basins represent a substantial part of these. In the 1980's some master theses concerned fish. Works concerning the taxonomy and morphology of crustaceans, inter-species interactions including the works on comensal rotifers living on crustaceans and the role of snails as intermediary hosts of trematods are just a few examples of the subjects dealt with. The works on the structure of the Grabia macrozoobenthos initiated in 1960s in Prof. Pawłowski's Department represent a substantial portion of the topics chosen by the graduates of the Faculty. Other problems, such as invertebrate drift and migrations, settling in various habitats, seasonal changes and the impact of anthropogenic changes upon the structure and behavior of zoobenthos community, also still enjoy equal interest. They refer to both the macrofauna of soft bottom as well as to phytophilous invertebrate assemblages. The production of dominant species of chironomids, a description of the water slater (*Asellus aquaticus*) population in catchment area water basins, the analysis of fry, attempts to assess the dynamics of nutrients and organic matter in rivers, and finally the description of meadows in the Grabia valley are further examples of the variety of

Table 2: The specification of master theses produced in departments of Faculty of Biology and Environmental Protection University of Łódź in years 1947–2002

Departments	Number of masters thesis	Percent
Department of Invertebrate Zoology and Hydrobiology	71	66
Department of Applied Ecology	12	11
Department of Ecology and Vertebrate Zoology	6	6
Department of Experimental Zoology and Evolutionary Biology	16	15
Department of Botany	2	2
Total	107	100

subjects dealt with by the graduates of the Institute of Ecology and Environmental Protection. This variety has to be complemented with a wide range of experimental works on the biology of caddis flies and water mites based on the material collected in the Grabia and conducted for many years by the Department of Experimental Zoology and Evolutionary Biology.

5. Other trends of the research

During the first, pioneer stage of works, in the 1950s and 60s, most of the attention was paid to recognition of the biological diversity of the macroinvertebrates of the river. Well, the stage for carrying out deeper synecological studies was set. Although the problems were dominated by biodiversity studies, in addition to and together with the mainstream research there were also studies on the taxonomy of selected groups and species: rotifers, leeches, stoneflies, blackflies and gammarids (PAWŁOWSKI 1934, 1936, 1948; WOJTAS 1961; KITTEL 1974; JAŹDŹEWSKI 1977, NIESIOŁOWSKI 1987) as well as studies of water invertebrate biology: rotifers, leeches, water bugs, bivalves, snails and true flies (PAWŁOWSKI 1934, 1935, 1955; JAŹDŹEWSKA 1966; KRAJEWSKI 1966; PIECHOCKI 1969a, 1975; NIESIOŁOWSKI 1980b).

Ecological studies play an important role in the achievements of the teams working on the Grabia River. Elements of autecology and the biocenology of invertebrates and fish in particular have been present since the very beginning and constituted an important element of the monographic works on various taxa. A series of such works is listed in the opening paragraphs of this paper. In the 1990s there were numerous strictly ecological works by GRZYBKOWSKA (1989, 1991), GRZYBKOWSKA and WITCZAK (1990), GRZYBKOWSKA et al. 1990, 1996) on the production and distribution of chironomids, the analysis of fish community by ZALEWSKI et al. (1990) and informations on the orb shell cockles (Sphaeriidae) by PIECHOCKI and STRZELEC (1999) as well as the paper by JAŹDŹEWSKA (1997) on mayflies from sandy bottom of the Grabia River, the dominant habitat in the river bed.

The analysis of the distribution of selected taxa (WOJTAS 1959, 1962b; KRAJEWSKI 1969; PIECHOCKI 1969b; JAŹDŹEWSKA 1971; NIESIOŁOWSKI 1980b; TOŃCZYK 2001 – Ph D Th.) allows us to learn in detail about the distribution of fauna in the longitudinal profile of the river. The zonal distribution of animals in water-courses is best documented in mountain and sub-mountain rivers, where environmental factors are highly variable. Such data for lowland rivers are usually not precise and not always allow for identification of the characteristic parts of a river. Extensive studies on

the Grabia made it possible to analyze these phenomenon in a small lowland river. Studies on the distribution of water insects alongside the river course (Plecoptera, Ephemeroptera, Simuliidae, Heteroptera, Odonata) and representatives of other hydrofauna groups (Hirudinea, Mollusca) show that the Grabia can be divided into three faunistical zones. The spring and stream zone (upper 20–30 km of the river) is characterized by a small number of highly specific species, most of which are present only in the upper course of the river. In the middle zone (between 20–30 and 60–70 km of the river course) the species richness is the highest among the studied groups. The lower zone (60–70 km to the estuary at 81 km) is also rich with species, but large river forms are predominant there. This zone is clearly influenced by the fauna of the Widawka and Warta Rivers.

The Grabia with its rich flora and fauna has recently become an object of studies into various aspects of river ecosystem. Studies concerning the functioning of drainage basin of small rivers are conducted in the Department of Applied Ecology. One subject of interest is the assessment of the flow of nutrients to higher trophic levels, combined with comparative characteristics of fish communities in a lowland and upland river (ZALEWSKI et al. 1990). Studies by BIS et al. (1998b, 2000) and BIS and HIGLER (2001) focused on analysis of the Grabia macrozoobenthos groups and habitat diversity in the light of processes in the river catchment area. Finally, it is worth stressing that the Grabia has become one of 47 European rivers included in multi-scale comparative studies of the macroinvertebrate of European flowing water conducted for the purpose of biomonitoring. The Grabia, together with Italian River Dese, was a test field for biological and hydrological testing methods in the V 2.3/2.4 UNESCO Program "Ecohydrology" (BRAIONI et al. 1998).

Numerous data collected over the course of many years of hydrobiological research and the high degree of natural profile of the river and its valley gave an impulse to launch large scale biocenologic studies in the 1990s. They were conducted in the Department of Invertebrate Zoology and Hydrobiology of the University of Łódź in co-operation with Dutch hydrobiologists from the Institute of Forestry and Nature Research in Wageningen. Between 1992–1995 the Program „Hydraulics and macroinvertebrates: hydrology, sandbottom stability and lowland streams” was implemented with a view to identifying the structure and dynamics of fauna groups in sandy bottom. In 1998–2000 a Polish – Dutch Project “Ecological descriptions of natural water systems in Central Poland” was carried out. At that time the Grabia River was a convenient model for analyses and comparisons. Both projects were designed to identify the structure of invertebrate communities in the Grabia and their complexity in the background of habitat diversity (in particular considering the diversity of microhabitats of the river environment). The studies were supposed to

result in a model which would constitute a reference point for works on renaturalisation of european streams, rivers and their valleys.

Taking into account all the scientific achievements presented above and the natural values of the river and its valley, the authors of this paper envisage some areas for future studies that could supplement the picture of the river with missing elements of fauna, their synthetic presentation, and dynamic aspects of the river community. Main tasks should encompass:

1. Further inventory studies of less-known groups and further analysis of the diversity of already well-examined groups. Such studies would allow us to assess the level of changes of hydrofauna over time and their nature and source.

2. Autecological studies of the best known groups of animals, including dominant species of leeches, snails, bivalves, peracarid crustaceans, mayflies, dragonflies, stoneflies, blackflies and chironomids.

3. Biological studies of key species.

4. Further studies of assemblages of flora and fauna, their structure and behavior.

5. Studies focused on the impact of abiotic factors upon the nature and structure of benthic communities.

The Grabia, being an object of many years' biological studies, is a linking element for subsequent generations of biologists in Łódź. Investigations into the river have integrated various scientific teams and led to research co-operation between various laboratories and departments. Fashions and interest in environmental biology have changed over time, emphasis was put on various aspects of studies, but the Grabia has remained the object of a large spectrum of studies. There are new scientific projects, more or less relating to the river and its basin. It seems that environmental studies based on detailed works on the biological diversity of the ecosystem could form an interesting proposal for research teams of the Łódź center into the near and more distant future.

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Master's theses:

Theses were produced in the Faculty of Biology and Environmental Protection (formerly Faculty of Mathematics and Natural History transformed later into the Faculty of Biology and Earth Sciences). Abbreviations: DIZH – Department of Invertebrate Zoology and Hydrobiology; DAE – Department of Applied Ecology; DEVZ – Department of Ecology and Vertebrate Zoology; DEZEB – Department of Experimental Zoology and Evolutionary Biology; DB – Department of Botany.

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