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Assessment of the Ecological Status and the Need for Renovation of Drainage Ditches in the Strumień Junikowski Catchment

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1. Introduction

In order to ensure proper water relations in any catchment it is crucial to maintain an adequate condition of drainage ditches. Drainage systems are responsible not only for appropriate moisture levels in agriculturally utilised soils, but also for the elimination of the negative impact of excess waters coming from spring thaw and torrential rains. In view of climate change and the resulting increasing frequency of extreme weather conditions, such as short-term abundant precipitation and droughts, elements of drainage systems will play an even more vital role (Bykowski et al. 2011, Liberacki & Olejniczak 2013). Considering the above, it is of critical importance to ensure serviceability of these systems (Sojka et al. 2019).

To maintain drainage structures in operable condition it is necessary to follow guidelines for their proper use and to perform maintenance operations at the required frequency. Maintenance of ditches consists in the preservation of the desired transverse shape and downgrade of the ditch bottom as well as the elimination and repair of all ditch bottom damage (Bielecki & Klus 1970). Basic maintenance operations include mowing of vegetation overgrowth, hoeing of plants rooted in the bottom and sediment removal (Kozaczyk et al. 2016). In practice these operations are frequently performed at excessively long intervals, resulting in massive ditch overgrowth and thus their reduced flow capacity. This leads to water bursting their banks and to flooding of adjacent agriculturally utilised land and urbanised areas. In the case of an insufficient flow rate in a ditch the amount of sediments also increases, resulting in a deterioration of water quality and promoting eutrophication. As it was stated by Joel et al. (2015),

overgrown ditches cease to serve their function of discharge outlets for excessive phosphorus compounds and start to be their generators. Hydraulic structures being elements of drainage systems, such as gates and weirs installed at ditches, also need to be adequately maintained. Maintenance of these structures consists e.g. in flushing of culverts under roads as well as inspections and repairs of their rings.

In Poland the problem related with an inadequate serviceability of drainage systems is much more complicated. Inadequate frequency of maintenance operations is not the only factor causing their improper functioning. Another problem is also connected with the depreciation of many drainage structures, built in the 1970's and 1980's and currently being in the final stages of their structural lifetime (Bykowski et al. 2011). Damaged and unserviceable drainage structures need to be reconstructed. Funds allocated in the past to their repairs as a rule were insufficient to meet the needs and covered only a small percentage of the actual requirements. In the Poznań county in the years 2010-2016 money transferred from public funds to finance maintenance and operation of drainage structures met only 5.5% annual demand (Stachowski et al. 2017).

Apart from the progressing depreciation of drainage structures another problem is also related with the identification of areas requiring maintenance works. For this reason researchers are focusing on the development of a method to estimate relative relevance of drainage in individual regions. It may prove useful in the preparation of a development strategy for a given area. Based on the results provided by such a method the scope of maintenance works and modernisation of drainage structures may be planned for specific regions (Kaca 2017). The condition of ditches is increasingly often evaluated applying the MADRAS (Minnesota Agricultural Ditch Research Assessment for Stability) method and the HEC-RAS programme. These tools take into consideration stability of banks and escarpments, their shape, slope and susceptibility to erosion, vegetation, as well as deposition and transport of sediments in the ditch (Avilés et al. 2018, Joel et al. 2015). As it has been observed by many researchers, in Poland the technical condition of these structures is most frequently assessed using a method proposed by Kaca and Interewicz (1991) with later modifications (Bykowski et al. 2014, Liberacki & Olejniczak 2013, Oleszczuk et al. 2017, Przybyła et al. 2017). This method only assesses the technical condition of drainage structures. It does not take into consideration the ecological status of the watercourse, even though these aspects are interrelated. Maintenance works performed on ditches (mowing of their banks and cleanout of the ditch bottom) have a significant environmental impact and may contribute to adverse environmental changes (Bodnar-Nowakowska 2007). Also such procedures as dredging and chemical weeding of ditches pose a significant threat endangering biodiversity (Dollinger et al. 2015).

For this reason the condition of a drainage system may not be definitely classified as good or bad solely depending on its technical condition. In view of the above the authors of this paper decided to undertake a comprehensive evaluation of both the need to renovate the system of drainage ditches and to assess its current ecological status.

2. The study area

The study was conducted on the catchment of the Strumień Junikowski, covering 48.89 km^2 and located in the central part of the Wielkopolskie province. It is situated in the city of Poznań and the town of Luboń as well as the neighbouring communes of Dopiewo, Tarnowo Podgórne and Komorniki (Fig. 1). According to the physico-geographical regionalisation system proposed by Kondracki (2013) this area is included in the mesoregion of the Poznańskie Lake District (315.51), being a part of the subprovince of the South Baltic Lake District (315) and the macroregion of the Wielkopolskie Lake Ditrict (315.5). The Strumień Junikowski of 11.7 km in length is the primary watercourse of the catchment.

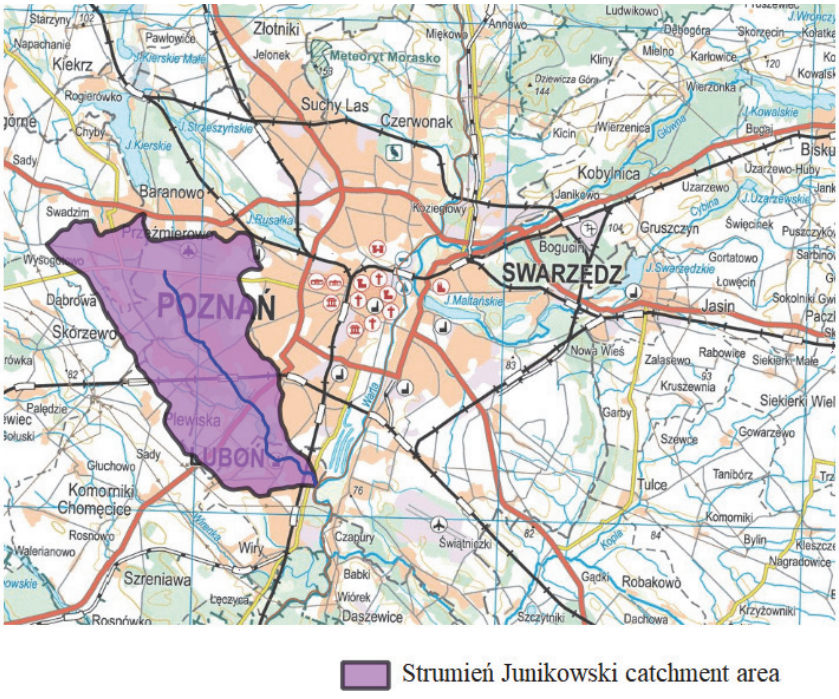

Fig. 1. Location of the Strumień Junikowski catchment area

Drainage ditches found in the analysed area were classified to three categories:

1. 1st order ditch – the Strumień Junikowski, as the main outlet,
2. 2nd order ditches – tributaries of the Strumień Junikowski (the Skórzynka, Ławica, Plewianka, Ceglanka),
3. 3rd order ditches – smaller ditches classified as drainage or roadside ditches flowing into 1st and 2nd order ditches.

It needs to be remembered that despite the extensive drainage network the analysed catchment is exposed to intensive anthropogenic pressure. The agricultural areas in that region are increasingly often subjected to urban sprawl. These processes cause a considerable increase in the paved surface area in the catchment, which is connected with increased surface runoff of waters from spring thaw and torrential rains.

3. Material and methods

The aim of this study was to assess the ecological status and needs for maintenance and renovation for drainage ditches in the Strumień Junikowski catchment. For this purpose available technical documentation of the drainage structures and base maps of the catchment were analysed. A site inspection was conducted (in April 2018), during which structures within the Strumień Junikowski and the other watercourses in the catchment were surveyed. Their technical condition was evaluated following the method proposed by Kaca and Interewicz (1991). The method was modified, eliminating the separate classification of operability and serviceability of these structure and replacing them with the general evaluation of their condition using descriptive notes of good, satisfactory and unsatisfactory (Bykowski et al. 2014), following the criteria used in Table 1. In the case of the other ditches in the analysed catchment (2nd and 3rd order ditches) a descriptive assessment of their need for renovation and modernisation was applied.

In the course of field inspections the degree of degradation was also evaluated in the Strumień Junikowski. It included the characteristics of habitats within the watercourse and bioindicator analyses applying the Macrophyte River Assessment Method (Szoszkiewicz et al. 2010). The method is based on the qualitative and quantitative assessment of the macrophyte species composition in the waters. MMOR research was conducted during the growing season in August 2018, when the plants were fully developed and identifiable. Aquatic plants were analysed along a 100m representative river stretch. Only macrophytes growing in the water were recorded (or at least rooted within the waters). Representative sections for habitats most commonly found near the river were selected for the study. The first point was dominated by patches of ruderal vegetation and bushes. The

second point was dominated by a forest habitat with patches of ruderal vegetation, small fragments of meadows and allotments. The third point is a typical wetland habitat. The fourth point was dominated by reeds and wastelands. The fifth point was located in the area of industrial development. Macrophytes were identified to species. Only in the case of algae identification to genus was considered sufficient. The presence of each taxon was recorded with a percentage, 9-point scale: 1 for 0.1%, 2 for 0.1-1%, 3 for 1-2.5%, 4 for 2.5-5%, 5 for 5- 10%, 6 for 10-25%, 7 for 25-50%, 8 for 50-75% and 9 for 75%, respectively. Based on the obtained Macrophyte Index for Rivers (MIR) and the Water Framework Directive the ecological status of catchment waters was evaluated. The assessment was performed only in the main watercourse of the catchment, assuming that the Strumień Junikowski is the receiving water of the other ditches and as a consequence its condition reflects the ecological status of the entire catchment.

Table 1. Assessment criteria for the technical condition of linear, hydraulic and communication structures (Bykowski et al. 2014)

Assessment criteria of the technical condition of linear structures				
Lp	**criterion**	**structure condition**		
		good	**satisfactory**	**unsatisfactory**
1	Singular ditches			
	◦ average depth [cm]	80 - 120	60 - 80 i 120 - 150	< 60 i > 150
	◦ silting [cm]	< 10	10 - 30	> 30
	◦ plants' average height [cm]			
	a) at the bottom	< 25	25 - 35	> 35
	b) on the scarp	< 25	25 - 50	> 50
2	Collective ditches			
	◦ average depth [cm]	90 - 130	70 - 90 i 130 - 160	< 70 i > 160
	◦ silting [cm]	< 10	10 - 20	> 20
	◦ plants' average height [cm]			
	a) at the bottom	< 20	20 - 30	< 70 i > 160
	b) on the scarp	< 10	10 - 20	> 20
Assessment criteria of the hydraulic & communication structures				
Lp	**criterion**	**structure condition**		
		good	**satisfactory**	**unsatisfactory**
1	Culvert's pipeline			
	◦ silting	< 10 %	10 - 30 %	> 30 %
	◦ cover	> 50 cm	30 - 50 cm	< 30 cm
	◦ concrete rings' arrangenent	proper arrangenent of rings	proper arrangenent of rings	rings misplaced, damaged
2	Road over the culvert			
	◦ ruts	no / < 10 cm	10 - 20 cm	ruts reaching rings
3	buldings bridgeheads	no fracture	small fractures	deep fractures

4. Assessment of the technical condition of drainage structures in terms of their maintenance and renovation

The field studies provided a survey of 38 concrete culverts over the entire length of the Strumień Junikowski and 31 box culverts in the Skórzynka watercourse. Their status was assessed, showing that for most structures located in the Strumień Junikowski it is good or satisfactory (Fig. 2). The greatest effect on this status was exerted by silting of the waters, which in extreme cases exceeded 30%. Another evaluated parameter was the structure headwater, which as a rule met the requirements of a good condition, i.e. over 50 cm. The primary problem for the culverts in the analysed watercourse was connected with progressing silting and overgrowing of these structures. In some of them concrete damage would also need to be repaired. During the field research it was observed that there are no small water retention devices on the watercourse. In the era of current climate changes and drought, it is extremely important to slow down the outflow. It is therefore necessary to increase the number of retention devices on the watercourse by building groundsills, barrages, sluice gates and small reservoirs. The implementation of such investments will also contribute to increasing the flood safety of urbanised catchment areas.

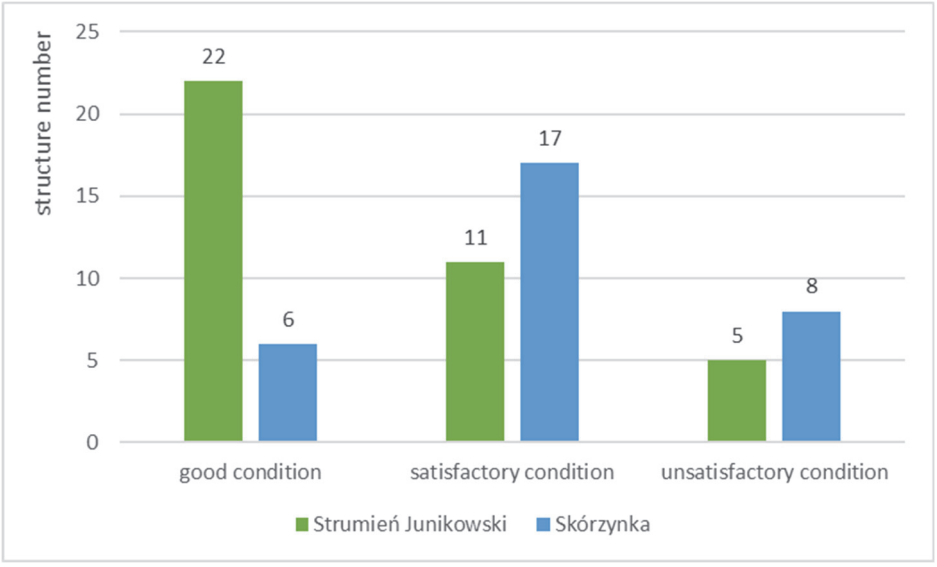

Fig. 2. Assessment of the condition of drainage structures

Field studies have shown that, in contrast to the Strumień Junikowski, the structures in the Skórzynka watercourse are in a worse condition. In 8 out of 31 culverts their condition was classified as inadmissible, i.e. not serving their function. One culvert is completely obstructed by the fallen bank openwork slabs. The parameter connected with headwater levels in the culverts was assessed as much better, as in none of the inspected structures it was classified as inadmissible. Within the administrative limits of the city of Poznań the structures are in optimal condition and they were classified as good (5 structures) and satisfactory (1 structure).

In the course of the conducted studies and field inspections the condition of linear structures was also assessed. This was based on such parameters as the mean depth of the watercourse, the degree of silting and the height of vegetation on the bottom and the escarpments. The condition of the linear structures in the Strumień Junikowski was assessed as satisfactory in over 60% of all cases (Fig. 3). Areas evaluated as being in the best condition, classified as good, included the initial segment of the watercourse, located near the airport, and the fragment at the outlet. The greatest problem observed in the Strumień Junikowski is related to the deposition of considerable amounts of rubbish and debris, particularly in the middle stretch of its course. Also numerous dead trees lying on the bottom obstruct water flow and contribute to increased silting. Over approx. 60% length of the Skórzynka watercourse its condition was assessed as satisfactory. In this case the greatest negative aspect, resulting in the deterioration of its evaluated status, is connected with the process of its vegetation overgrowth. The height of bank vegetation very often is greater than the satisfactory value and exceeds 50 cm. The relatively low flow rate in the Skórzynka watercourse contributes to accelerated ditch overgrowth. Another problem is also related with the observed high degree of silting (over 30 cm). For several years now the level of silting has not improved, as confirmed by earlier studies. Field measurements conducted in 2010 showed that the entire length of the Skórzynka watercourse is subject to observed high degree of silting with a thickness of approx. 35 cm (Przybyła et al. 2011).

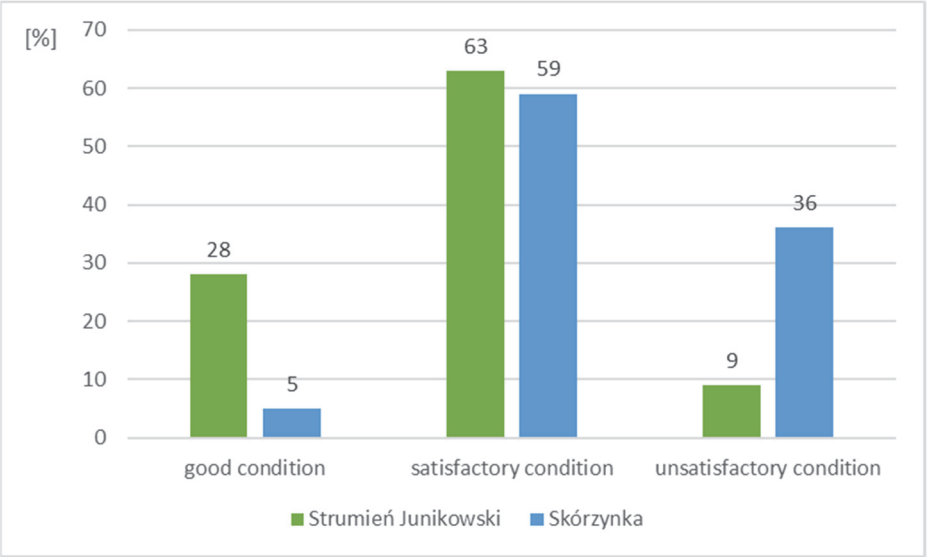

Fig. 3. Assessment of condition of linear structures

The conducted field inspection facilitated also an assessment of needs for maintenance and renovation in the lower order watercourses in the Strumień Junikowski catchment. The condition of the channels in 3rd order ditches was classified as unsatisfactory. As a result of long-term neglect their basic parameters determining water flow have greatly deteriorated. These ditches are overgrown and silted to a considerable degree. Culverts located in those ditches (approx. 60) are damaged and silted. Most of the 3rd order tributaries need to be thoroughly renovated by mowing of their bottoms and banks (minimum twice a year), cleanout of silting to a depth of min. 30 cm as well as restoration of the original cannel parameters (sloping). Damaged or improperly prepared culverts either require modernisation or need to be replaced. It was found that in relation to the total length of 3rd order ditches flowing to the Ławica watercourse (1242 m) over 70% require renovation. In the Plewianka watercourse 100% 3rd order tributaries require mowing of the vegetation overgrowth and removal of bottom silting. An analogous situation was observed in ditches flowing into the Ceglanka watercourse. In contrast, the Skórzynka has no tributaries. The conducted analysis showed that also 2nd order drainage ditches, i.e. the Ławica, Skórzynka, Plewianka and Ceglanka watercourses, as well as their drainage structures need to be renovated. This is determined mainly by the accelerated inflow of waters from the catchment, resulting from its intensive management and the increased area of impermeable (building development). The largest number of structures

which need to be replaced is located in the Skórzynka watercourse (15 culverts). In turn, the lowest number of culverts classified as requiring renovation was found in the Ławica and Ceglanka (3 structures each). In the Plewianka watercourse 6 culverts need to be replaced (Table 2).

Table 2. A list of 2nd order ditches that require renovation

2nd order ditches' name	the mouth of Strumień Junikowski [km]	total length of the river [km]	lenght in the need of renovation [km]	lenght in the need of renovation [%]	total number of structures	structures in the need of modernisation	structures in the need of modernisation [%]
Ławica	9+750	2,30	1,30	56,5	8	3	37,5
Skórzynka	5+778	7,75	3,00	38,7	31	15	48,4
Plewianka	5+240	4,37	3,20	73,2	11	6	54,5
Ceglanka	4+480	2,23	1,50	67,3	8	3	37,5

5. Survey and phytosociological valuation of the watercourse

The Strumień Junikowski practically over its entire length is characterised by a high degree of anthropisation. Natural and semi-natural habitats accompany the dominant ruderal habitats, as confirmed by studies conducted to date (Dyderski & Wrońska - Pilarek 2018). Large areas along the river banks are covered by synanthropic species, primarily allochthonous. *Impatiens glandulifera* have been reported in the source section of the river. Naturally, it occurs in Central Asia, in the western Himalayas. It was imported as an ornamental plant and is an expansive synanthrope limiting biodiversity of river valleys. At present it is found not only in Asia and Europe, but it is a problem also in North America and New Zealand. Among synanthropes *(Echinocystis lobata)* was also observed here. It is an annual climber from the *Cucurbitaceae* family. In Poland its cultivation, breeding and sale are strictly controlled. In the middle stretch of the river at Junikowo, at Rzepińska street and at Niezłomnych street, large patches of *Reynoutria sachalinensis* were also reported. The latter is one of the 20 most expansive plants in the world. It is a perennial, forming underground rhizomes, which hinders effective control of this species. It is found most frequently in habitats located along watercourses. In Poland it is recommended as an energy crop, although opinions on this subject vary. Due to its rapid growth, dynamic spread and threat to native biodiversity all cultures of this plant are controlled. At the Junikowski Cemetery in the vicinity of old drainage ditches a unique association of *Selino carvifoliae-Molinietum* meadows is found, which has been threatened for almost two decades now (Borysiak 2001). The molinia meadows of varying moisture levels *(Molinion)* are Natura 2000 habitats (6410) with its representative species, purple moor-grass *(Molinia caerulea).* Habitat 6410 is a semi-natural biotope, which developed as a secondary habitat replacing cleared forests. Both its

formation and maintenance are connected with a specific management system, consisting in the annual late mowing performed in late August or even early September. These biotopes affect biodiversity also due to the system of their use. Neglected meadows excluded from use are transformed through natural succession into tall herb or shrub communities or forests. In rebogged sites they may be transformed into sedge beds. Molinia meadows are connected with mineral and organogenic soils with a very wide trophic amplitude – from poor, weakly acid soils to very fertile, alkaline soils, frequently with marked gleying (Kącki and Michalska 2010). A characteristic feature of these habitats is connected with the variable ground water table. In the beginning of the vegetation season it is very high and meadows are often flooded. In the summer season the groundwater level falls very low, frequently below the rhizosphere of many plant species. Water circulation in soil may result from natural conditions or be artificially generated by wetland drainage operations. Slightly different conditions are found in sieve-molinia grasslands (subtype 6210-2). These habitats develop on more acidic soils relatively poor in nutrients. Their vegetation composition floristically resembles acid sedge fens and fens. Water circulation in the soil is not very dynamic and the habitat is permanently moist (Matuszkiewicz 2018).

In selected sampling points (Fig. 4) bioindicator analyses were performed using the Macrophyte River Assessment Method (MMOR), assessing the degree of watercourse degradation, primarily in terms of the trophic status. A total of 22 macrophyte species were identified, including algae (1 taxon), pteridophytes (1 taxon), mosses (1 taxon), monocotyledonous (7 taxa) and dicotyledonous plants (12 taxa). Using the survey data the metric, i.e. the Macrophyte River Index (MIR), was calculated, which when referred to reference vales for a given macrophyte type facilitates evaluation of the ecological status as defined by the Water Framework Directive (2000/60/EC) (Szoszkiewicz et al. 2010).

Obtained MIR values indicate high variation in the ecological status of the Strumień Junikowski over its entire length (Fig. 5). The highest index value was recorded at Rzepińska street at the Junikowski Cemetery (point 2). This index classified waters to the very good ecological status based on the MIR boundary values for 5 classes of ecological status for lowland sandy and organic rivers. Waters in point no. 4 below the ponds were also classified as having a very good ecological status. The headwater and outlet points were found within the good ecological status according to the EU WFD. The lowest class was recorded for water flowing next to ponds in Kopanina. The recorded index classified water to the poor ecological status class.

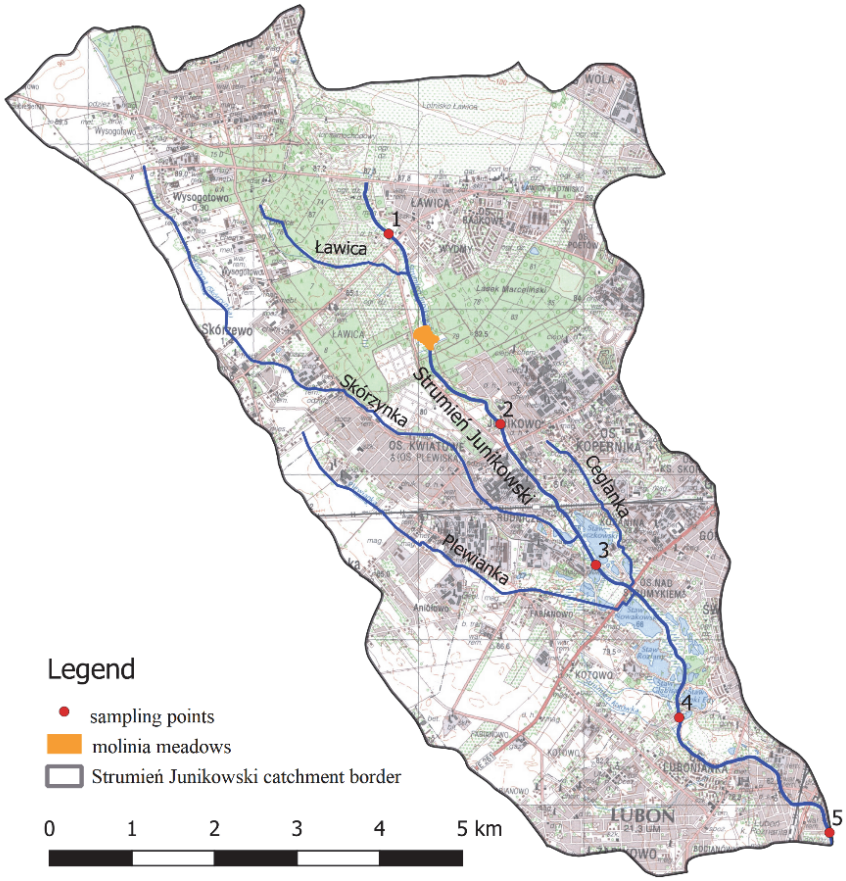

Fig. 4. Location of sampling points of the Macrophyte River Assessment Method

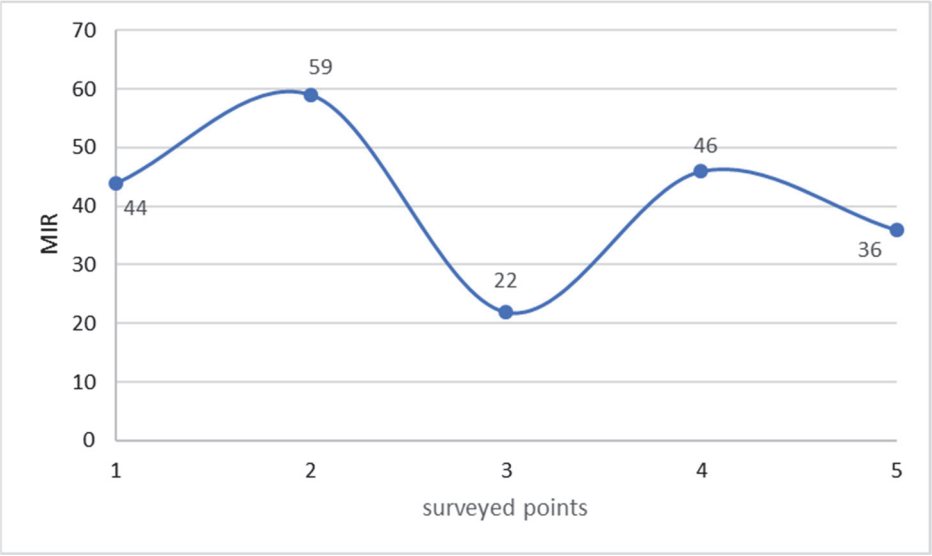

Fig. 5. Results of the Polish Macrophyte Index for Rivers in the surveyed points of the watercourse

In the course of macrophyte analyses colonies of rare slime molds *(Myxomycota, Mycetozoa,* also referred to as *Eumycetozoa)* were also identified. Formerly the group comprising several hundred species had been classified to fungi and later to fungus-like protists. At present it is classified to eukaryotic organisms belonging to *Amoebozoa,* i.e. a taxon of eukaryotes with a supergroup status. Although they had been considered to be a class of cryptogams, particularly fungi, they are closer to typically animal *Protista* (protozoans). This is indicated by the occurrence of mobile forms and feeding through phagocytosis. Thus they are not directly related with plants, animals or fungi.

6. Conclusions

Studies conducted on the ecological status and requirements for renovation and maintenance of drainage ditches in the Strumień Junikowski catchment provided grounds for the formulation of the following conclusions:

1. The Strumień Junikowski catchment is undergoing gradual degradation due to the increasing share of urbanised areas.
2. Obtained values of the Macrophyte Index for Rivers (MIR) indicate considerable variation in the ecological status of the Strumień Junikowski catchment, which may also result from the technical condition of drainage structures in that area, modifying its hydromorphological conditions.

3. Analyses conducted using the Macrophyte River Assessment Method showed that in the stretch between Ławica and Grunwaldzka street the degree of anthropopressure on the watercourse, resulting from habitat transformations and influx of pollutants, is the smallest. This is indicated by the highest MIR value and the identified macrophyte species, characterised by a narrow ecological amplitude.
4. Evaluation of the condition of drainage structures located in the Strumień Junikowski showed that they are in good condition. In contrast, the condition of the 3rd order watercourses was classified as unsatisfactory. Their immediate renovation (cleanout of silt deposits and mowing of vegetation overgrowth) are recommended.
5. The Strumień Junikowski catchment is constantly being developed, which leads to an accelerated and increased outflow of precipitation and spring thaw waters. For this reason maintenance of the drainage ditches in optimal condition is crucial and has a tremendous impact on the reduction of flooding risk in the areas adjacent to the watercourse.
6. In order to increase the flood safety of urbanised areas in the Strumień Junikowski catchment it is recommended to build small retention reservoirs and gates in the analysed watercourse, thus improving its retention capacity.

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Abstract

Drainage systems are responsible for maintaining adequate soil moisture levels and alleviating negative consequences of excess water coming from the spring thaw as well as torrential rains. In the face of the climate change and pervasive extreme weather conditions, the importance of these ameliorative measures will be increasing. It is imperative to ensure appropriate functioning of these drainage systems. To be effective they need to be adequately operated and maintained, with maintenance measures performed appropriately and with required frequency. Basic ditch conservation procedures include mowing to remove vegetation overgrowth and cleanout to remove sediment. A significant problem in Poland results from an insufficient number of renovation and conservation operations performed on drainage systems, their gradual deterioration and depreciation. As a result, it is crucial to assess the need for renovation and modernisation of drainage ditches. It needs to be remembered that these operations interfere with the environment and may cause some unfavourable ecological changes. In view of the above, the authors of this publication conducted a thorough evaluation of both the required renovation of the investigated drainage ditch system and its current ecological status. The study area comprised the Strumień Junikowski catchment with the main outlet, i.e. Strumień Junikowski, its tributaries (the Skórzynka, Ławica, Plewianka, Ceglanka) as the main collection ditches and field ditches. During the field inspection the existing drainage structures were inventoried, with their technical condition assessed according to Kaca and Interewicz (1991). In this paper the characteristics of habitats found in the drainage area of the watercourse are presented along with the bioindicator analysis performed using the Macrophyte River Assessment Method. Based on the MIR index the ecological status of the stream was assessed and classified in accordance with the Water Framework Directive. The results demonstrate a significant variation of the ecological state of Strumień Junikowski over its entire course. The condition of the drainage structures in the drainage area varies. In the main watercourse of Strumień Junikowski the inspected culverts are in a good condition in contrast to the ones located on the tributaries. Vegetation overgrowth and sediment deposition in the ditches are major problems of the drainage area. This is caused by a lack of effective and systematic maintenance and renovation of the watercourses. The Strumień Junikowski drainage area is further being developed, which is associated with a rapid and increased discharge of rainwater and snowmelt. Thus it is necessary to maintain drainage ditches to ensure their optimal condition, which is essential to decrease the risk of flooding in the urban areas adjacent to the watercourse.

Keywords:
renovation, modernisation, maintenance, drainage ditches, drainage measures, ecological status, Macrophyte River Assessment Method

Ocena stanu ekologicznego oraz potrzeb renowacji rowów odwadniających zlewni Strumienia Junikowskiego

Streszczenie

Systemy melioracyjne odpowiadają za zapewnienie prawidłowego uwilgotnienia gleb oraz niwelowanie negatywnych skutków nadmiaru wód pochodzących z roztopów oraz deszczy nawalnych. W obliczu zmian klimatycznych oraz coraz częstszego występowania ekstremalnych zjawisk pogodowych rola urządzeń melioracyjnych będzie wzrastać. Niezwykle ważne jest zatem zapewnienie prawidłowego funkcjonowania tych systemów. Warunkiem skutecznego działania urządzeń wodnomelioracyjnych jest ich właściwa eksploatacja, a także konserwacja, prowadzona w odpowiednim zakresie oraz z określoną częstością robót. W Polsce dużym problemem jest niewystarczająca ilość przeprowadzanych renowacji i konserwacji urządzeń melioracyjnych oraz ich stopniowe starzenie się i dekapitalizacja. Dlatego też niezwykle ważne jest dokonanie oceny potrzeb renowacji i modernizacji rowów melioracyjnych. Należy pamiętać przy tym, że zabiegi te istotnie ingerują w środowisko i mogą przyczynić się do niekorzystnych zmian ekologicznych. Autorzy niniejszej publikacji przeprowadzili kompleksową ocenę zarówno potrzeb renowacji systemu rowów odwadniających jak i jego aktualnego stanu ekologicznego. Obiekt badań stanowiła zlewnia Strumienia Junikowskiego z rowem pierwszego rzędu – Strumieniem Junikowskim (główny odbiornik), rowami drugiego rzędu – dopływy Strumienia Junikowskiego (Skórzynka, Ławica, Plewianka, Ceglanka) oraz rowami trzeciego rzędu. Podczas wizji terenowej zinwentaryzowano istniejące budowle wodnomelioracyjne oraz oceniono ich stan techniczny według metody Kacy i Interewicza (1991). W pracy przedstawiono również charakterystykę siedlisk występujących w obrębie cieku oraz wykonano badania bioindykacyjne z wykorzystaniem Makrofitowej Metody Oceny Rzek (MMOR). Na podstawie otrzymanego wskaźnika MIR (Makrofitowego Indeksu Rzecznego) sklasyfikowano stan ekologiczny wód strumienia wg wytycznych Ramowej Dyrektywy Wodnej. Otrzymane wyniki badań wskazują na duże zróżnicowanie stanu ekologicznego Strumienia Junikowskiego na całej jego długości. Stan budowli melioracyjnych w zlewni również nie jest jednolity. W obrębie głównego cieku – Strumienia Junikowskiego, zinwentaryzowane przepusty są w dobrym stanie w przeciwieństwie do tych znajdujących się na jego dopływach. Dużym problemem zlewni jest też wzrastające zarastanie oraz zamulenie rowów. Przyczyną tego stanu jest brak wystarczającej i systematycznej konserwacji i renowacji cieków. Zlewnia Strumienia Junikowskiego cały czas jest poddawana dalszej zabudowie, co wiąże się nagłym i zwiększonym odpływem wód opadowych i roztopowych. Z tego powodu zachowanie rowów odwadniających w optymalnym stanie jest bardzo ważne i ma ogromny wpływ na zmniejszenie ryzyka podtapiania terenów zurbanizowanych przyległych do cieku.

Słowa kluczowe:

renowacja, modernizacja, konserwacja, rowy odwadniające,
urządzenia wodnomelioracyjne, stan ekologiczny, Makrofitowa Metoda Oceny Rzek