

**DEVELOPMENT OF DRWEŃCKIE LAKE IN OSTRÓDA
FOR TOURIST AND RECREATIONAL PURPOSES,
AND ITS IMPACT ON THE BURDEN TO THE NATURAL
ENVIRONMENT IN THE SHORELINE ZONE**

***Katarzyna Parszuto, Renata Tandyrak, Michał Łopata,
Sylwia Mikulewicz, Jolanta Grochowska, Julita Dunalska***

Department of Water Protection Engineering
University of Warmia and Mazury in Olsztyn

Key words: recreation, tourism, shoreline burden, land development for tourism, lake.

A b s t r a c t

Our analysis deals with the land development and management for tourist and recreational purposes around Drwęckie Lake, a water body lying in the limits of the town Ostróda. A lot of tourists and residents in summer season can be attributed to the spatial management, a wide range of hospitality facilities and many opportunities to practice water sports and to hold mass events. Another aspect we analyzed was the influence that these various forms of development for tourism and recreation could have on the natural environment of Drwęckie Lake. To this aim, the shoreline burden indicator (*K*) values and the lake's burden class were calculated. It has been concluded that both land and water shore zones are considerably loaded due to the densely developed space and increasingly intensive tourist and recreational activities. Current situation can lead to excessive degradation of the lake's water and depreciation of the tourist value of the entire area.

**ZAGOSPODAROWANIE TURYSTYCZNO-REKREACYJNE JEZIORA DRWEŃCKIEGO
NA TERENIE OSTRÓDY – WPŁYW NA OBCIĄŻENIE STREFY BRZEGOWEJ**

***Katarzyna Parszuto, Renata Tandyrak, Michał Łopata, Sylwia Mikulewicz,
Jolanta Grochowska, Julita Dunalska***

Katedra Inżynierii Ochrony Wód
Uniwersytet Warmińsko-Mazurski w Olsztynie

Słowa kluczowe: rekreacja, turystyka, obciążenie strefy brzegowej, zagospodarowanie turystyczne, jezioro.

Abstrakt

Przeanalizowano zagospodarowanie turystyczno-rekreacyjne Jeziora Drwęckiego w Ostródzie. Sposób zagospodarowania, bogata oferta gastronomiczna i noclegowa oraz atrakcje związane z możliwością uprawiania sportów wodnych i organizowania imprez masowych przyciągają w sezonie letnim wielu turystów i mieszkańców miasta. Zbadano także wpływ form użytkowania turystyczno-rekreacyjnego na środowisko przyrodnicze Jeziora Drwęckiego, wyznaczając wskaźniki stopnia obciążenia strefy brzegowej (K) oraz klasy obciążenia jeziora. Stwierdzono, że obydwie strefy – lądowa oraz wodna – są w znacznym stopniu obciążone z powodu intensywnego zagospodarowania przestrzeni oraz intensyfikację różnorodnych form użytkowania turystycznego i rekreacyjnego. Może to być przyczyną nadmiernej presji antropogenicznej i wpływać negatywnie na przeobrażanie obszarów zlokalizowanych wokół Jeziora Drwęckiego. Obecna sytuacja może doprowadzić do nadmiernej degradacji wód jeziora i w efekcie obniżyć walory turystyczne tego obszaru.

Introduction

Lakes can be an attractive tourist destination not only because of the quality of lake water or their size (DUDA-GROMADA et al. 2010, REMENYIK et al. 2013). What matters is also the visual quality of a lake's surroundings, which frequently depends on buildings or woods on the lake's shores (FURGAŁA-SELEZNIOW et al. 2012, POTOCKA 2013). For the recreational use, the most valuable are lakes with clean water, gently sloping shores, sandy bottom and lying in an afforested catchment (KOZUCHOWSKI 2005, SERAFIN et al. 2014, TANDYRAK et al. 2016). Another important aspect is the tourist and recreational development of the adjacent land, which can attract both local residents and visitors (DUDA-GROMADA et al. 2010, HALL 2010, RYAN et al. 2010, HAKUĆ-BŁAŻOWSKA and TURKOWSKI 2013).

The use of lakes for tourism and recreation often creates negative influences on the environment, giving rise to conflicting situations between the hospitality industry and environmental protection (BNIŃSKA 2000, DUNALSKA et al. 2015, TANDYRAK et al. 2015). Excessive numbers of tourists in areas around water bodies, which have a specific tourism capacity, stimulates an anthropogenic pressure and causes degradation of nature (CURTIS 2003). The adverse impact of accumulated tourist traffic arises from such events as grass trampling and burning, ground damage by cars, littering, atmospheric pollution, for example with exhaust fumes (KRUKOWSKA and KRUKOWSKI 2013). All these negative circumstances threaten both plants and animals. When the number of visitors coming to a given place seems exaggerated, tourists and residents feel uncomfortable, which can trigger outbursts of aggression (PUCZKÓ and RÁTZ 2000, SUPREWICZ 2008, PAWLIKOWSKA-PIECHOTKA 2009).

The land development for the tourism industry leads to transformations of the lithosphere (FURGAŁA-SELEZNIOW et al. 2011, PASEK and NOWAK-ZALESKA 2011), changes in the hydrosphere (quantity and quality of waters) (SKRZYP-

CZAK et al. 2011), increased traffic and noise, higher emission of waste (SIKORSKA-WOLAK 2004) and even climate changes (PATTERSON et al. 2006).

SKŁODOWSKI (2009) lists numerous factors connected with water tourism which have an adverse impact on water environment and woods. They include pollution of the habitats of fish and invertebrates caused by two-stroke engines, which emit to water between 10 to 20% of the used diesel oil and fuel mixture (nitrogen oxide, hydrocarbons, carbon, sulphur oxides, lead compounds, PAHs), chemical poisoning of animals due to spills of oil and fuel while filling up cars (lead(IV) oxide, ethyl bromide, short- and long-chain hydrocarbons, dichloroethane, phosphorus, zinc, sulphur oxides, etc.), water contamination due to discharge of wastewater with chemical compounds to lake waters rather than at marinas (about 25% of boat users), introduction of detergents to lake waters by swimmers who apply sun protection creams or persons who wash up dishes in lake waters using detergents.

Another source of negative impact is the creation of waves and turbulences, responsible for the erosion of the lake bottom and shores as well as the soil leaching around tree roots, which may then fall into the water. Defects observed along the shores are attributed to a variety of causes, for example anchoring of boats (BRAMWELL and POMFRET 2007, KURLETO 2014), bathing, hiking, camping or digging holes in the ground serving as earth closets, digging steps in the ground for easier access to the lake when fishing, damaging plants with oars or boat propellers, frightening animals with the sounds and views of moving boats. Finally, there is a notable negative influence of land engineering, e.g. transformations of shores, construction of embankments, the leveling of ground (SKŁODOWSKI 2009).

Overtly intensive plans for the spatial management of areas around natural water bodies are frequently a cause of excessive pressure and transformations of the natural environment (HAKUĆ-BŁAŻOWSKA and CYMERMAN 2011). As a consequence, a completely transformed area may preclude any tourist or recreational function.

The essence of this study has been to evaluate Drwęckie Lake, in Ostróda, regarding its appeal to tourists and possible use for tourism and recreation. The assessment was followed by an analysis of the effect of land management for tourism and recreation as well as the forms of recreational use available today on the burden to the natural environment in the lake's shoreline zone.

Material and Method

Research object

Drwęckie Lake lies at the latitude 53°42' 57" N 19 and longitude 55°11" E in the Mazurian Lake District in Poland, in the catchment of the rivers Drwęca and Vistula. Location of Drwęckie Lake is presented in Figure 1. The lake's surface area is 880.8 ha. There is an islet Ostrów on the lake, covering 10.8 ha. The maximum length and width of the lake are 15,500 and 1,100 m, respectively. The maximum depth is 22.3 m, and the average depth is 5.7 m. The shoreline length is 40,600 m and shoreline development index is 3.86 (CHOIŃSKI 1991, DARMOCHWAŁ and RUMIŃSKI 1996).

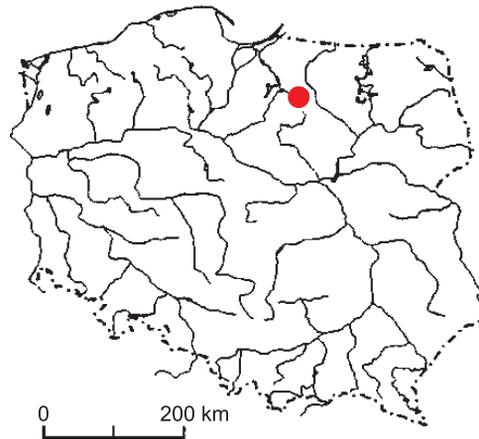


Fig. 1. Location of Drwęckie Lake (NE Poland; The Mazurian Lake District)

The southern shores are flat, wooded and waterlogged. To the north, the shores are high and sometimes steep, descending towards the lake. Most of the lake's surroundings are covered in forests, especially in the north and off the northern part of the lake's shoreline called the Samborowska Channel. The bottom is irregular and muddy, same as the slopes of the shoal (WALUGA and CHMIELEWSKI 1996).

According to the 2014 data the lake belongs to class II of degradation sensitivity, which means it is relatively resistant to the impact of its catchment. The lake waters were classified between water quality class III and classless category (*Informator turystyczno-przyrodniczy* 2014).

Methodology

The data collected during the field observations in the spring of 2014 were plotted onto topographic maps (Figure 2) and a satellite map of this area, so as to illustrate the current state of the land management for tourism and recreation around Drwęckie Lake in the town limits of Ostróda. The shore zone was divided into the land and water parts. The land shore zone is the area from the shoreline into the land over a distance of 200 m, and it has been divided into sections 500 m in length along the lake's banks. The water shore zone is the area from the shoreline into the lake, 100 m wide and likewise divided into 500-meter sections along the banks.

The total surface area was determined as well as the areas under different forms of development for the tourist and recreational purposes (planimetric representation – Sokkia Placom KP 90 N planimeter).

Each distinguished area (P_i – area under different types of tourist use) was assigned valuation scores (B_i), which should differentiate between the types and direction of impact on the natural environment, according to the indicators proposed by MIKA (2004) and FURGAŁA-SELEZNIOW et al. (2011). The total area (P_o) of the designated field is a unit valid for the sum of products of the determined valuation scores and the character of a given area. The index of the burden to the natural environment in the lake shore zone (K) was derived from the formula (MIKA 2004):

$$K = \sum \frac{P_i \cdot B_i}{P_o}$$

K – index of tourism infrastructure burden on the natural environment in the lake shore,

P_i – area under different types of tourist use,

B_i – valuation score,

P_o – reference unit area (total area of designated field).

The calculated value of the shore burden index (K) and lake burden class served to estimate the degree of impact produced by individual forms of tourism and recreation on the natural environment in the shore zone of Drwęckie Lake, in accordance with the guidelines specified in Table 1.



Fig. 2. Topographic map of Drwęckie Lake on the Ostróda area (Geoportal)

Table 1

Class burden indicator of the natural environment for a specific character recreational use of lake's shoreline (MIKA 2004)

Class of lake's shoreline burden	Degree of lake's shoreline burden	Value range of <i>K</i> indicator
I	considerable	> 0.1
II	moderate	0.1–0.01
III	slight	< 0.01

K – index of tourism infrastructure burden on the natural environment in the lake shore (shore burden index)

Results

Description of the development and management for tourism and recreation of Drwęckie Lake in the town limits of Ostróda

The field observations carried out in 2014 verified good accessibility of Drwęckie Lake from the western and southern sides, near urbanized areas, where there are numerous foot paths and a bikeway. The shores are well maintained. Litters are almost absent and found only sporadically close to some buildings.

The tourist and recreational development around Drwęckie Lake comprises such facilities as the Marina, the premises of the Ostróda-Elbląg Cruise Company, an amphitheatre, a stadium, the Willa Port Hotel, the Promenada Hotel, many restaurants, a water-ski lift, a canoeing track, a lifeguarded bathing beach, small jetties, a pier, summer cottages, water equipment rentals, a fountain and a playground.

Drwęckie Lake marks the beginning of a cruising trail on the Elbląg Canal. The canal, recently renovated, is equipped with a system of lifts for ships that is unique in the world. In order to surpass a 100-meter difference in water table levels, boats enter carriages which are then pulled over five consecutive inclined planes. The mechanism is powered by the water flow in the canal. In 2012, a Decision of the President of the Republic Poland was passed that instituted the Elbląg Canal as a Heritage Site.

Other popular water trails are the Ostróda-Stare Jabłonki Canal, the John Paul II Trail from Ostróda to Iława, the Drwęca River Trail, as well as the trails connecting Ostróda and Toruń, Ostróda and Tabórz, Ostróda and Idzbark, Ostróda and Elbląg and many others connecting to such lakes as Pauzeńskie, Szelał Wielki and Szelał Mały. The section of the trail from Miłomłyn to Ostróda runs through some waterlogged areas, which necessitated the construction of four locks: Miłomłyn (water elevation of 2.8 m),

Zielona (1.4 m), Ostróda and Mała Ruś (1.4 m), which are now an additional technical attraction for tourists (STACHURSKI 2002). The company Żegluga Ostródzko-Elbląska Sp. z o.o in Ostróda, which was founded in 2011, is currently among the best thriving cruise operators in the western part of Mazury.

Drwęckie Lake is an excellent destination for the pursuit of all types of water sports and active pastime. Among the recreational facilities there is a waterski lift, which was installed in 2009. It is 800 m long and can be remote controlled from the shore. The lift can serve 9 users at a time. There is some expensive infrastructure on the shore, for example a building with changing rooms and showers for waterskiers, and an equipment rental. The estimated number of waterskiers and wakeboarders using the lift each season is several thousand. The water lift attracts both amateur and professional athletes who practice water sports. Since 2010, the All Poland Wakeboarding Championships have been held on Drwęckie Lake. In 2014, Ostróda hosted the European Wakeboarding Championships. In 2009, two Olympic-size oar racing tracks (1000 and 500 m) were opened on Drwęckie Lake. Last but not least, there are several boat races taking place in Ostróda, which all attest to the rich tradition of water sports in Ostróda.

A large pier stretching lakeward out from the shore of Drwęckie Lake is the largest construction of this type in Polish inland waters. At the far end, there is a big gazebo and a wooden promenade around it, over the lake waters, which is used for walks, social meetings but also for open-air concerts in the summer. There are benches and some carved wooden statues on the pier. Nearby, there are many cafes and restaurants as well as hotels and hostels, serving needs of all tourists.

A roofed amphitheatre, co-funded by the European Union, was constructed near the lake's shores in 2012. This is the largest roofed amphitheatre in Warmia and Mazury and has become a venue of various artistic and cultural events, including summer shows of cabarets, music concerts, theatrical performances, all drawing crowds of local residents and visitors (for example, the Dance Music Festival Preselection, the Sea Days, the Days of Ostróda, the Stars Olympic Games and supporting concerts, the Ostróda Reggae Festival). In the same year, a municipal fountain with an audiovisual system of colourful lights and musical sounds was built. The fountain's central element is a statue of a fisherman.

Preparations for the Euro 2012 Games in Poland included the construction of a stadium with football pitch and the renovation of Collis Park near Drwęckie Lake. The football pitch was created mainly for playing football matches. It is classified as auxiliary infrastructure. It is equipped with additional sports and recreational facilities and devices, for example two

tennis courts, a climbing wall, a skateboarding ramp and a roofed ice rink. There are also toilets, showers, changing rooms, and rooms for medical and uniformed services. The youngest generation was taken into consideration when restoring Collis Park. There are table tennis tables, a rope park, an open-air gym, fitness paths, a basketball court and a mini golf course.

There is a bathing beach near the park and a hotel. The beach has the most favourable location as it is well exposed to the sun and presents high landscape values. This is a large beach with good access to the lake's shores. It is also easily accessible to visitors, who are offered such infrastructure as changing rooms, toilets, a first aid point, and a water equipment rental. This bathing beach is an example of a developed facility, adapted to seasonal use, with a designated although unguarded bathing area and a jetty (in 2014). There are other water equipment rentals, for example at the Morliny Sailing Marina, the LOK marina or the Sokół Sports Club, which rent equipment to tourists for charge fees.

Indicators defining the degree of impact of tourism on the natural environment of the lake's shore zone

Values of the indicator (K) reflecting the load on the lake's shore zone (both land and water) were determined in relation to various types of tourism and recreation activities. Subsequently, classes of the burden to the natural environment in the shore zone were assigned (Table 2 and Table 3). The forms of land development for tourism and recreations identified within the shore zone of Drwęckie Lake in the town limits of Ostróda are presented in Figure 3.

The land and water shore zone of Drwęckie Lake was divided into 7 fields of different surface areas, adding up to 67.723 ha of the land (Table 2) and 32.138 ha of the water shore zone (Table 3).

The highest degree of loading onto the lake's natural environment was detected in fields 5 and 6 (Figure 4), where the dominant land use types are accommodation and active recreation facilities for tourists, which are examples of permanent land development and therefore most strongly stimulate denaturalization of the environment (Figure 3).

In field 6, where the degree of burden was the highest, the land shore zone K index reached 1.09, which corresponds to class I of natural environment load (Table 2, Figure 4). The underlying cause was the presence of sports facilities, such as a stadium and tennis courts. Moreover, much of this part of the lake's shores is occupied by a hotel and three other, smaller guesthouses. There is also Collis Park near the stadium but it is less of a burden than the

Table 2
Evaluation of the influence of various forms of tourism and recreation on the environment of land shore zone of Drwęckie Lake in the town limits of Ostróda

Number of field	Area of land shore zone [ha]	The forms of tourist exploit – area [ha] $P_1; P_2; P_3; P_4; P_5$ – Symbol of area					Valuation score (B_i) for different kind of tourist impact					K	K_1
		tourist settlement	Active recreation areas			other recreational	P 1	P 2	P 3	P 4	P 5		
			P_1	P_2	P_3								
1	8.6950	–	–	–	–	3.6300	–	–	–	–	1	0.420	I
2	9.6550	0.0640	0.0620	0.0560	–	–	5	4	3	–	–	0.080	II
3	7.7260	–	–	0.1000	–	–	–	–	3	–	–	0.040	II
4	13.2210	0.2040	0.3090	0.1100	–	1.5100	5	4	3	–	1	0.430	I
5	8.3140	1.4580	0.0091	0.1100	–	1.1900	5	4	3	–	1	1.060	I
6	10.7180	0.3390	1.8940	0.1200	–	2.0600	5	4	3	–	1	1.090	I
7	9.3940	0.7090	0.6080	0.0900	–	–	5	4	3	–	–	0.660	I
Total	67.7230	2.7740	2.8821	0.5860	0.0	8.3900							

K – shore burden index; K_1 – class burden index

Table 3
Evaluation of the influence of various forms of tourism and recreation on the environment of water shore zone of Drwęckie Lake in the town limits of Ostróda

Number of field	Area of water shore zone [ha]	The forms of tourist exploit – area [ha] $P_1; P_2; P_3; P_4; P_5$ – Symbol of area					Valuation score (B_i) for different kind of tourist impact					K	K_1
		tourist settlement	Active recreation areas			other recreational	P 1	P 2	P 3	P 4	P 5		
			P_1	P_2	P_3								
1	4.9500	–	–	–	–	–	–	–	–	–	–	0.000	III
2	4.7690	–	–	–	0.0314	–	–	–	2	–	–	0.013	II
3	4.8740	–	–	–	–	–	–	–	–	–	–	0.000	III
4	3.7750	–	–	–	0.0074	–	–	–	2	–	–	0.004	III
5	4.7110	–	1.6850	–	0.0091	–	–	4	–	2	–	1.430	I
6	4.2270	–	0.3130	–	0.0070	–	–	4	–	2	–	0.300	I
7	4.8320	–	1.7360	–	0.0041	–	–	4	–	2	–	1.440	I
Total	32.1380	0.0	3.7340	0.0	0.0590	0.0							

K – shore burden index; K_1 – class burden index

other elements of permanent land development. Another example of development for tourism and recreation is the foot and bicycle path along the lake. The water shore zone in this field comprises a jetty and part of a canoe track, which correspond to forms of the recreational use of lake waters – K index reached 0.30 (Table 3, Figure 3).

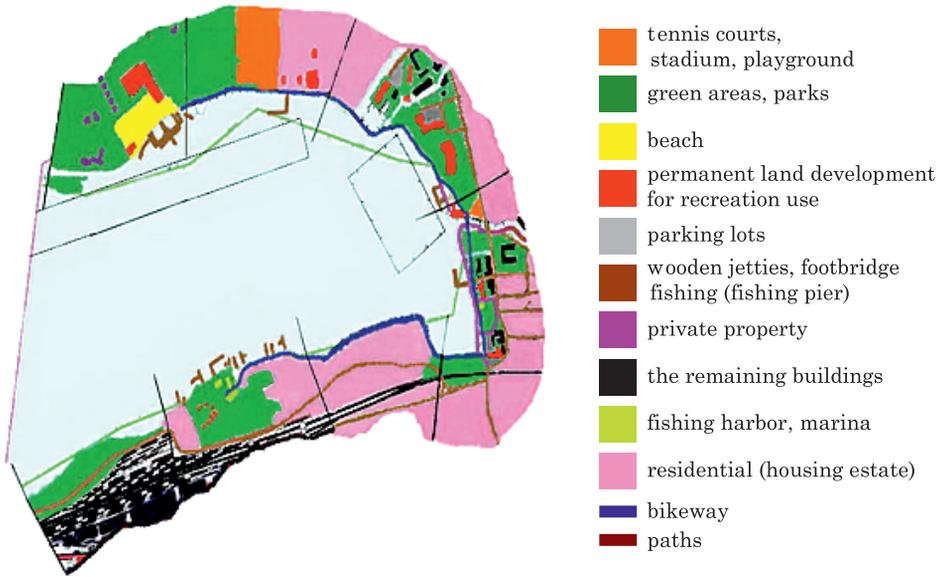


Fig. 3. The forms of development of tourist and recreational in the shoreline zone of Drwęckie Lake in the town limits of Ostróda



Fig. 4. The degree of burden the shoreline of Drwęckie Lake caused by the land development for tourism and recreation

The second most heavily burdened field is the one designated number 5, where the land shore zone K index was 1.06, which also corresponds to the natural environment burden class I (Table 2, Figure 4). There are four accommodation facilities in this field, including 3 exclusive hotels, and several other summer apartments. There is an amphitheatre next to a hotel, a hardened surface car park and a water equipment rental with changing rooms. The catering industry is represented by a tavern and hotel restaurants. The bicycle and foot path runs along the lake's shores. There are also some green areas. The water part of this field was assigned the environmental load index value of 1.43 (Table 3). The reason is the waterski lift with a jetty, which attracts high numbers of tourists in the summer season (Figure 3).

Other fields classified to the first class of environmental burden (land shore zone) are the ones numbered 1, 4 and 7 (Table 2, Figure 4). Field 1 is dominated by woods and green areas (Figure 3). Field 4 contains such elements of permanent land development as a lodging object with a casino, cafes and restaurants, including one in the shape of a ship. There are also green areas, a playground for children and a bicycle and foot path. The water part of the field 4 is occupied by the pier, which puts the field into class III of environmental burden (slightly loaded) – Table 3, Figure 4. Field 7 has such elements of land development as the recently opened Plaza Hotel with an unguarded beach and a water equipment rental, and a private residence. The water part of the field has been assigned a distinctly high value of the K index, i.e. 1.44 (considerable load), due to the presence of a jetty and part of the canoe track (Table 3, Figure 3).

The remaining fields 2 and 3 belong to class II land zone burden (moderate load) (Table 2, Figure 4). Except for a marina and a water equipment rental, the land parts of these fields do not comprise any significant tourist industry amenities. There is a cycle and foot path, same as in the other fields of the lake's shoreline. The water part of field 2 contains 9 small wooden jetties (Figure 3), which also corresponds to class II (Table 3, Figure 4).

The index K for the land shore zone did not reach, in any of the fields, such values that would classify the fields into class III of environmental load due to excessively intensive land development for tourism and recreational purposes (Table 2). Only fields 1, 3 and 4 in water part, where there were just small jetties (Figure 3), had the K index values of less than 0.01 (Table 3) and were classified as belonging to class III (slight load) – Figure 4.

Due to the high K index values representing the environmental burden caused the land development for tourism and recreation (Table 4), both the land and water shore zones belong to class I of the environmental burden.

Table 4
Degree of land and water shore zone burden (K) of Drwęckie Lake, and their class burden (K_1)

Specification	K shore burden index	K_1 class burden index
Degree of land shore zone burden	0.52	I
Degree of water shore zone burden	0.47	I

Discussion

A degree of the transformation of nature by tourism depends on the character and form of tourism (PUCZKÓ and RÁTZ 2000), level of tourism industry development, planning and development of suitable infrastructure (POMUCZ and CSETE 2015), organization and management of tourist traffic, ecological awareness of tourists and the resistance of the natural environment to man-made pressure (MIKA 2000, BRAMWELL and POMFRET 2007).

A more intensive tourist flow often produced negative influences on the natural environment (KRUKOWSKA and ŚWIECA 2012). The most common adverse consequences are worse contamination of waters, air and soil, degradation of the landscape, interference with the biological balance, the littering of beaches and forests, and a higher level of noise (SIKORSKA-WOLAK 2004). When lakes are used for recreational purposes, the shoreline zones of water bodies are exposed to the most severe environmental risk (FURGAŁA-SELEZNIOW et al. 2011). The underlying cause of degradation is the intensive development of infrastructure for tourists and holidaymakers. This attracts more visitors, including those who come to beaches for sunbathing and swimming, to attend cultural and sports events, to ride motorboats or go on cruise ships, etc. (DEJA 2001, KURLETO 2014).

Drwęckie Lake is popular with many tourists for a number of reasons. First, it is located centrally in a town and therefore it is easily accessible. Second, the areas along the lake's shores offer many places to stay overnight (hotels, summer apartments, etc.) and to eat (restaurants, cafes). There is also well-developed infrastructure for water sports and excellent facilities for holding mass events. The lake attracts crowds of tourists and town residents in the summer season (STASIAK and WŁODARCZYK 2003, DÁVID et al. 2007, VASVÁRI et al. 2015).

Our research has demonstrated that both land and water shore zones around Drwęckie Lake are heavily burdened by various forms of land development for tourism and recreation. Among the seven distinguished fields, as many as five in the land zone, are considerably loaded while the remaining two are submitted to moderate burden. In the water part of the shore zone, 3 out of 7 fields have been determined to be considerably loaded, 1 field is distinguished by moderate burden and 3 other fields belong to class

III (slightly loaded). This confirms that the growth of infrastructure and increasing tourist attractiveness can exert strong pressure on the natural environment (PUCZKÓ and RÁTZ 2000, FURGAŁA-SELEZNIOW et al. 2010, KRUKOWSKA and KRUKOWSKI 2013).

Strong man-made pressure applied to waters and shores of Drwęckie Lake is created by mass events. Crowds of people are drawn to the lake by numerous attractions such as water sports shows and competitions. Consequently, all the factors mentioned by SKŁODOWSKI (2009) can produce adverse influences on the transformations occurring in the natural surroundings and waters of Drwęckie Lake.

Factors that affect negatively the natural environment, when accumulated intensively over a relatively small area, become an obvious threat to nature. Moreover, they can also threaten any further growth of tourism and recreation in this location because of the unwanted transformation of the surroundings or deteriorated water quality (HALL and HARKÖNEN 2006, PANTELIĆ et al. 2012, LOPES et al. 2016).

Our investigations have revealed certain threats to the shoreline area of Drwęckie Lake within the town limits due to the more and more intensive land development for tourism and recreation. Meanwhile, it should be emphasized that this is the most important water body that contributes to the development of tourism and recreation in the administrative district of Ostróda (NAWROCKA 2011, STASIAK and ROCHMIŃSKA 2011, SZWACKA-MOKRZYCKA 2012.). Hence, it is necessary to observe interactions between the growth of the tourism industry and the state of the natural environment (REMENYIK et al. 2013, POMUCZ and CSETE 2015). It is advisable to foresee whether the consequences of the lake's degradation will force the municipal authorities to undertake, some time in the future, costly efforts to reverse the trend and restore the lake (ŁOPATA 2013).

Conclusions

In this article, we draw attention to the importance of skilful spatial management within the lake's direct catchment. Another important point to make is that lake protection efforts should involve such actions that prevent excessive growth of infrastructure addressed to tourists. Denaturalization of the environment within the shore zone of a lake may lead to its future exclusion from use as a tourist destination due to unacceptable water quality. Hence, constant monitoring of environmental consequences brought about by the tourism industry is in order.

References

- BNIŃSKA M. 2000. *Wpływ innych użytkowników jezior na środowisko i gospodarkę rybacką*. In: *Stan rybactwa jeziorowego w 1999 roku*. Ed. A. Wołos. IRŚ, Olsztyn, pp. 34–44.
- BRAMWELL B., POMFRET G. 2007. *Planning for lake and lake shore tourism: complexity, coordination and adaptation*. *Anatolia*, 18(1): 43–66.
- CHOIŃSKI A. 1991. *Katalog jezior Polski. Cz. 2. Pojezierze Mazurskie*. Wyd. Nauk. UAM Poznań.
- CURTIS J.A. 2003. *Demand for water-based leisure activity*. *Journal of Environmental Planning and Management*, 46: 65–77.
- DARMOCHWAŁ T., RUMIŃSKI M.J. 1996. *Warmia Mazury, przewodnik*. Agencja TD, Białystok.
- DÁVID L., NAGY Z., GERGELY S. 2007. *New Vasarhelyi Plan – reservoirs for tourism along River Tisza in Hungary*. In: *Handbook of lakes and reservoirs. A sustainable vision of tourism*. Eds. A. Németh, L. David. Department of Tourism and Regional Development, Karoly Robert College, Gyöngyös, pp. 34–41.
- DEJA W. 2011. *Przydatność rekreacyjna strefy brzegowej jezior Polski*. Wyd. Nauk. Bogucki, Poznań.
- DUDA-GROMADA K., BUJDOSÓ Z., DÁVID L. 2010. *Lakes, reservoirs and regional development through some examples in Poland and Hungary*. *GeoJournal of Tourism and Geosites*, 5(1): 16–23.
- DUNALSKA J., GROCHOWSKA J., WIŚNIEWSKI G., NAPIÓRKOWSKA-KRZEBIETKE A. 2015. *Can we restored badly degraded urban lakes?* *Ecological Engineering*, 82: 432–441.
- FURGAŁA-SELEZNIOW G., CUDNIK M., SKRZYPCZAK A., MAMCARZ A. 2011. *Zmiany w przestrzeni turystycznej jezior pod wpływem użytkowania rekreacyjnego ich strefy brzegowej (na przykładzie jezior Skanda i Kortowskie)*. In: *Przestrzeń turystyczna czynniki, różnorodność, zmiany*. Eds. M. Durydiwka, K. Duda-Gromada. Wyd. UW Wydział Geografii i Studiów Regionalnych, Warszawa, pp. 263–270.
- FURGAŁA-SELEZNIOW G., SANKIEWICZ D., SKRZYPCZAK A., MAMCARZ A. 2010. *The impacts of tourism and recreation on lake shores: a case study of Limajno and Stobajno Lakes in north-eastern Poland*. In: *Lake tourism research. Towards sustaining communities and lake environments*. Eds. N. McIntire, R. Koster, H. Lemelin. Occasional Research Publication, Lakehead University, Centre for Tourism & Community Development Research, Thunder Bay, Canada, 99–111.
- FURGAŁA-SELEZNIOW G., SKRZYPCZAK A., KAJKO A., WISZNIEWSKA K., MAMCARZ A. 2012. *Touristic and recreational use of the shore zone of Ukiel Lake (Olsztyn, Poland)*. *Pol. J. Nat. Sc.*, 27(1): 41–51.
- HAKUĆ-BŁAŻOWSKA A., CYMERMAN R. 2011. *Principles of developing limnological restrictions in the planning process*. *Polish Journal of Environmental Studies*, 20(6): 1501–1511.
- HAKUĆ-BŁAŻOWSKA A., TURKOWSKI K. 2013. *Possibilities for sustainable tourism development in the county of Mrągowo (Poland)*. *Pol. J. Nat. Sc.*, 28(1): 71–80.
- HALL C.M. 2010. *Lakes as sustainable tourism destinations: integrating conservation and development*. In: *Lake tourism research. Towards sustaining communities and lake environments*. Eds. N. McIntire, R. Koster, H. Lemelin. Occasional Research Publication, Lakehead University, Centre for Tourism & Community Development Research, Thunder Bay, Canada, pp. 5–8.
- HALL C.M., HARKÖNEN T. 2006. *Lake tourism: an introduction to lacustrine tourism systems*. *Aspects of Tourism*, 32: 3–26.
- Informator turystyczno-przyrodniczy 2014*, <http://jezioro.com.pl/jeziora/jezioro.html?id=330>, access: 22.06.2016.
- KOZUCHOWSKI K. 2005. *Walory przyrodnicze w turystyce i rekreacji*. Wyd. Kurpisz, Poznań.
- KRUKOWSKA R., KRUKOWSKI M. 2013. *Spatial differentiation of tourist infrastructure in the riparian zone of the Białe Lake (Middle-East Poland)*. *Pol. J. Nat. Sc.*, 28(1): 81–89.
- KRUKOWSKA R., ŚWIECA A. 2012. *Tourism and recreation in the Łęczyńsko-Włodawskie Lake District (Middle-East Poland) survey results*. *Pol. J. Nat. Sc.*, 27(4): 393–405.
- KURLETO M. 2014. *Importance of lakes for tourism and ecosystems in some of South Pacific countries*. *Advanced Research in Scientific Areas, EDIS*. Publishing Institution of the University of Zilina, Slovakia, pp. 55–59.
- LOPES F.A., DAVIES-COLLEY R.J., VON SPERLING E., MAGALHÁES A.P. 2016. *A water quality index for recreation in Brazilian freshwaters*. *Journal of Water and Health*, 14(2): 243–254.
- ŁOPATA M. 2013. *Rekultywacja jezior – metody, uwarunkowania, etapy działań*. In: *Antropopresja na ekosystemy wodne a ochrona przyrody i aktywizacja rybactwa*. Eds. J. Domagała, R. Czerniawski, M. Pilecka-Rapacz. Uniwersytet Szczeciński, Barlinek, pp. 61–83.

- MIKA M. 2000. *Turystyka jako czynnik przemian środowiska przyrodniczego*. Prace Geograficzne, 106: 73–98.
- MIKA M. 2004. *Turystyka a przemiany środowiska przyrodniczego Beskidu Śląskiego*. IGiP UJ, Kraków.
- NAWROCKA E. 2011. *Rozwój turystyki i przestrzeń. Implikacje dla polityki turystycznej*. Ekonomia, 5(17): 171–185.
- PANTELIĆ M., DURDEV B., STANKOV U., DRAGIĆEVIĆ V., DOLINAJ D. 2012. *Water quality as an indicator of local residents' attitudes towards tourism development. A case study of settlements along Veliki Bački Kanal, Vojvodina, Serbia*. Knowledge and Management of Aquatic Ecosystems, 404: 9.
- PASEK M., NOWAK-ZALESKA A. 2011. *Obciążenie rekreacyjne Lasów Oliwskich w świetle ich chłonności naturalnej*. Journal of Ecology and Health, 15(4): 199–202.
- PATTERSON T., BASTIANONI S., SIMPSON M. 2006. *Tourism and climate change: two-way street, or vicious/virtuous circle?* Journal of Sustainable Tourism, 14(4): 339–348.
- PAWLKOWSKA-PIECHOTKA A. 2009. *Zagospodarowanie turystyczne i rekreacyjne*. Wyd. Novae Res, Gdynia.
- POMUCZ A.B., CSETE M. 2015. *Sustainability assessment of Hungarian Lakeside tourism development*. Periodica Polytechnica Social and Management Sciences, 23(2): 121–132.
- POTOCKA I. 2013. *The lakescape in the eyes of a tourist*. Quaestiones Geographicae, 32(3): 85–97.
- PUCZKÓ L., RÁTZ T. 2000. *Tourist and resident perceptions of the physical impacts of tourism at Lake Balaton, Hungary: issues for sustainable tourism management*. Journal of Sustainable Tourism, 8(6): 458–478.
- REMENTYIK B., TÓTH G., DÁVID L., SZÜCS C., VASA L., UAKHITOVA G. 2013. *Lakes under pressure: data on the development of lake tourism in Hungary*. Pol. J. Nat. Sc., 28(1): 119–130.
- RYAN C., HUIMIN G., CHON K. 2010. *Tourism to polluted lakes. Issues for tourists and the industry. An empirical analysis of four Chinese lakes*. Journal of Sustainable Tourism, 18(5): 595–614.
- SERAFIN A., BANACH B., SZCZUROWSKA A., CZERNAŚ K. 2014. *Estimation of potential loads of contaminants generated by beach tourism on lake Zagłębozce in two summer seasons, 2008 and 2010*. Teka Komisji Ochrony i Kształtowania Środowiska Przyrodniczego OL PAN, 11: 181–190.
- SKORSKA-WOLAK I. 2004. *Turystyka w rozwoju lokalnym*. Wyd. SGGW Warszawa.
- SKŁODOWSKI J. 2009. *Oddziaływanie turystyki wodnej na ekosystemy leśno-jeziorne*. Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej, Rogów, R. 11, 4(23): 267–273.
- SKRZYPCZAK A., PIĄTKOWSKA A., FURGAŁA-SELEZNIOW G., MAMCARZ A. 2011. *Przestrzeń turystyczna i potencjał rekreacyjny Zalewu Wiślanego*. In: *Przestrzeń turystyczna czynniki, różnorodność, zmiany*. Eds. M. Durydiwka, K. Duda-Gromada. Wyd. UW Wydział Geografii i Studiów Regionalnych, Warszawa, pp. 293–301.
- STACHURSKI A. 2002. *Ostróda i okolice*. Wyd. Agencja Fotograficzno-Wydawnicza Mazury.
- STASIAK A., ROCHMIŃSKA A. 2011. *Regionalne strategie rozwoju turystyki w Polsce – stan w 2010 roku*. In: *Turystyka polska w latach 1989–2009*. Ser. *Warsztaty z Geografii Turyzmu*. Eds. B. Krakowiak, J. Latosińska. Wydawnictwo Uniwersytetu Łódzkiego, Łódź, pp. 39–52.
- STASIAK A., WŁODARCZYK B. 2003. *Produkt turystyczny – miejsce*. Turyzm, 13(1): 55–80.
- SUPREWICZ J. 2008. *Socjologia turystyki*. Wyd. WSSP Lublin.
- SZWACKA-MOKRZYCKA J. 2012. *Znaczenie turystyki w strategii rozwoju gminy*. Studia Ekonomiczne i Regionalne, 5(1): 28–33.
- TANDYRAK R., ŁOPATA M., GROCHOWSKA J. 2015. *Rekultywacja jezior miejskich w aspekcie ich przydatności rekreacyjnej*. In: *Przestrzeń w turystyce – znaczenie i wykorzystanie*. Eds. M. Durydiwka, K. Duda-Gromada. Wyd. UW Wydział Geografii i Studiów Regionalnych, Warszawa, pp. 515–524.
- TANDYRAK R., PARSZUTO K., GROCHOWSKA J. 2016. *Water quality of Lake Elk as a factor connected with tourism, leisure and recreation on an urban area*. Quaestiones Geographicae, 35(3): 51–59.
- VASVÁRI M., BODA J., DÁVID L., BUJDOSÓ Z. 2015. *Water-based tourism as reflected in visitors to Hungary's lakes*. GeoJournal of Tourism and Geosites, 15(1): 94–106.
- WALUGA J., CHMIELEWSKI H. 1997. *Jeziora okolic Olsztyna*. Przewodnik Wędkarski (2). Wyd. IRŚ, Olsztyn.