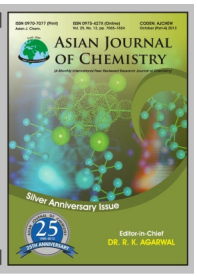
Asian Journal of Chemistry; Vol. 25, No. 18 (2013), 10225-10229

ASIAN JOURNAL OF CHEMISTRY

http://dx.doi.org/10.14233/ajchem.2013.15241



Vulnerability Assessment of Lakes on the Degradation in Barlinecko-Gorzowski Landscape Park

PIOTR DANISZEWSKI

Department of Biology, University of Szczecin, 13 Waska Street, 71-415 Szczecin, Poland

Corresponding author: E-mail: daniszewski73@gmail.com

(*Received*: 30 January 2013; *Accepted*: 11 November 2013) AJC-14371

The purpose of the work was to determine the impact of use on the evolution of water quality in lakes basin covered by tests. The studies covered seven tanks along with their drainage basins (the direct and total) Barlinecko-Gorzowski landscape located in the Park. In order to determine the impact of the estimated load of nitrogen and phosphorus compounds, reaching into the lake from the direct catchment area (as rafting area) and the total (as the supply of courses). Received loads of phosphorus were compared with the limit and dangerous cargoes for the test tanks. The work was also assessed and the impact of the natural resistance of the water catchment area of the lakes in the degradation the pace of delivery to them.

Key Words: Land use, Lake catchments, Nitrogen compounds, Phosphorus compounds, Water quality.

INTRODUCTION

Vulnerability assessment of the lakes in the degradation of water status parameters is the determining factor of the lake. This indicates whether the lake is prone to influences from the outside, which can be a drain of water or waste water discharges into the tank[1-6].

Adopted procedure consists in determining the impact on the quality of the waters of lake anthropogenic factors, understood as the use of catchment area, in conjunction with the natural factors that can potentially increase or decrease the size of this impact[3,5,7-12]. Natural factors affect susceptibility to degradation of the lakes and their resistance to the supply of matter from the catchment area[7,13-19].

This work shows the influence of catchment areas for water quality using the load of nitrogen and phosphorus to lakes and of getting tributaries of the confluence of the surface[4,20,6,7,8,18,11,12]. On the basis of the size of the cargo and the natural susceptibility and resistance of the tank was established, which may result from the use of the seven lakes basin Barlinecko-Gorzowski park the landscape with its natural context.

EXPERIMENTAL

Nature Park of Barlinecko-Gorzowski was created in October 1991. The Nature Park of Barlinecko-Gorzowski is more than 55 000 ha forests, lakes, fields, meadows and characterized by a great diversity of habitats and abundant life forms[21].

In the area of the Park, which was created 5 to protect the most valuable reserves, communities of plants and habitats of animals:

Rocky Jar Libberta: It covers the protection of the Gorge and hills moraine. Extremely rare in Western Pomerania rocks lime-gravel and boulders are surrounded by oak-beech forest, erratic[21].

Debina: Reserve forest protective team called the **Grand Central Europe**, which grow stately oaks and beeches with a touch of lime and hornbeam and pine age. In a clean environment has kept as many as 50 species of arboreal lichen[21].

Branded Mud: The land of swamps and bogs, with characteristic vegetation for them like mud, swamp, cranberry ordinary. This place is visited quite often by the eagles[21].

The water reserve of the **Przylêzek river**. It includes the portion of the river, the coastal slope and the surrounding stands from over a 100-year-old with beech. The mountain nature of course: pure and cold water create appropriate conditions to live salmonids[21].

Forest reserve **Wilanów** protects the natural mixed forest with beech trees, oaks and pine trees and building[21].

Forms of nature protection in the park include animate and inanimate nature monuments as well: 41 trees, 1 boulder, 3 rocks and retrieved from "God's gift"[21].

The studies covered seven lakes of the nature park of Barlinecko-Gorzowski.

Barlineckie lake: The area of the lake covers 260 hectares, the depth reaches 18 m, maximum length is 3.8 km lake is located in the north. Barlineckie parts of the park, at a height of 57 m above sea level and is part of the Mysliborskie[21].

Glebokie lake: The surface of the lake Glebokie in Barlinek is: 4.65 ha, maximum depth-8 m[21].

Lubiszewko lake: The surface of this lake covers 52 ha, depth, width is 11.8 m dating back to 520 m, length up to 2100 m. Lake is located at a height of 63,3 m above sea level[21].

Przyleg lake: The surface of the Lake is 43.2 ha, depth to 5.9 m, 650.0 m width, the length of 1,100 m[21].

Chlop lake: The surface of the lake is 58.7 ha, depth goes back to 16 m, width of 470 m and length to 1760 m. Lake is located on the height of 59.1 m above sea level and belongs to the catchment area of the river Santocznej[21].

Lubie lake: The surface of the lake is 58.7 ha, depth goes back to 16 m, width of 470 m and length to 1760 m. Lake is located on the height of the peasant 59.1 m above sea level and belongs to the catchment area of the river Santoczna[21].

Wielgie (Dankowskie) lake: The area of the lake covers 90.2 ha, depth is 7.7 m, width 920 m and the length of the 1880 m. It is situated at a height of 69.7 metres above sea level. The lake is located in the western part of the Dobiegniewskie[21].

Studies were carried out during 2008-2012. With each of the three measuring stations on the tested water samples were taken two separate lakes for chemical analysis.

Total catchment management and direct way it was found using GIS (Geographical Information System), using land-use maps[4]. Extracted the individual levels of use according to the classification adopted for Polish. Based on maps drawn up about the way spatial surfaces and calculated their shares in the total divisional catchment area. Natural susceptibility to degradation by is specified by Kudelskiej *et al*.[17] and the role of the drainage area in the provision to them of matter-by Bajkiewicz-Grabowskiej[1].

The size of the load of nitrogen and phosphorus in the water being carried by water course (momentary load) was calculated as the product of their concentrations and the instantaneous flow volume. Instantaneous load of phosphorus getting into the tank became the starting point of the calculation of the courses of annual value.

Based on the equation proposed by Giercuszkiewicz-Bajtlik[20] estimated the annual load of nitrogen and phosphorus compounds, derived from surface runoff.

Coefficients of annual nitrogen and phosphorus loads from areas of different land cover, atmospheric inputs and their retention have been averaged coefficients on the basis of the information contained in the work of several workers[11,18,7,6,19] (Table-1).

The total load of phosphorus introduced spot and area per unit area were recalculated by the rafting lake and adopted for the annual load of phosphorus from drainage area the use of sources. The value of the cargo was laden with dangerous and calculated on the basis of the criterion of maximum Vollenweidera[12] and then set out the categories of threat tanks according to Hillbricht-Ilkowskiej and Kayak[5].

RESULTS AND DISCUSSION

The results of the seven lakes of basin Barlinecko-Gorzowski park the landscape are given in Tables 2-6.

On the basis of the study, it can be concluded that the quality of the waters of lake catchment land use affects the way the lake (direct and total) and its natural conditions. The water of the lakes Barlineckie, Glebokie, Lubiszewko, Przyleg, Chlop, Lubie, Wielgie has a high ability to deliver. A significant load of nitrogen and phosphorus compounds reaching the courses and boat ride, combined with natural surface

TABLE-1
COEFFICIENTS OF ANNUAL NITROGEN AND PHOSPHORUS LOADS FROM AREAS OF DIFFERENT LAND COVER, ATMOSPHERIC INPUTS AND THEIR AVERAGED RETENTION COEFFICIENTS

Coefficients		Nitrogen	Phosphorus	Data source
		(kg ha^{-1})		
Surface runoff from:	Forests	3.92	0.225	Szyper *et al*.[11]
	Meadows and pastures (grasslands)	8.5	0.17	Likens[18]
	Arable lands	7.84	0.45	Szyper *et al*.[11]
	Built-up lands (urban) areas	2.5	0.1	Szyper *et al*.[11]
Atmospheric input		2,0	0.2	Kajak[7]
Retention		0,41	–	Jensen *et al*.[6]
		–	0.57	Uchmanski *et al*.[19]

TABLE-2
VULNERABILITY OF ANALYZED LAKES TO DEGRADATION

Parameters	Barlineckie		Glebokie		Lubiszewko		Przyleg	
	Value	Score	Value	Score	Value	Score	Value	Score
Mean depth (m)	7.1	2	3.2	3	5.2	2	2.5	3
The ratio of lake volume, thous. (m^3), to the length of the shoreline (m)	1.3	3	0.5	3	0.3	3	0.3	3
Water stratification (%)	23.5	2	21.4	2	26.2	2	24.8	2
The quotient of active lake bottom (m^2) and epilimnion volume (m^3)	0.03	1	0.02	1	0.04	1	0.02	1
Annual water exchange (%)	62	2	25	1	57	2	79	2
Schindler's coefficient, (m^2 m^{-3})	2.5	2	0.8	1	4.7	2	3.6	2
Land use type in the direct catchment (%)	68.5f	1	57.3f	1	75.8f	1	79.3f	1
Result	1.85		1.71		1.85		2.00	
Vulnerability	II		II		II		II	

Explanations: F-forests.

TABLE-2(c, d)
VULNERABILITY OF ANALYZED LAKES TO DEGRADATION

Parameters	Chlop		Lubie		Wielgie	
	Value	Score	Value	Score	Value	Score
Mean depth (m)	6.4	2	3.1	3	3.5	3
The ratio of lake volume, thous. (m^3), to the length of the shoreline (m)	1.0	3	0.3	3	0.2	3
Water stratification (%)	26.2	2	28.5	2	25.8	2
The quotient of active lake bottom (m^2) and epilimnion volume (m^3)	0.05	1	0.07	1	0.04	1
Annual water exchange (%)	98.4	2	79.6	2	83.5	2
Schindler's coefficient, (m^2 m^{-3})	5.7	2	6.2	2	6.9	2
Land use type in the direct catchment (%)	83.7f	1	75.3f	1	63.5f	1
Result	1.85		2.00		2.00	
Vulnerability	II		II		II	

Explanations: f-forests.

TABLE-3
ASSESSMENT OF CATCHMENT AS A SOURCE OF MATTER INPUT TO ANALYZED LAKES

Paramenters	Barlineckie		Glebokie		Lubiszewko		Przyleg	
	Value	Score	Value	Score	Value	Score	Value	Score
Lake coefficient	73.2	2	41.7	1	36.5	1	30.8	1
Balance type of lake	t-fl	3	t-fl	3	t-fl	3	t-fl	3
Catchment morphometry: river network density (m km^{-2})	0.2	1	0.1	1	0.1	1	0.2	1
Mean slope of the catchment (m km^{-2})	26.1	3	13.7	2	14.2	2	25.8	3
areas without drainage (%)	5.4	3	8.6	3	9.3	3	7.2	3
Geological structure	s	3	l	0	s	3	s	3
Land use type	f-a	1	f	0	f-a	1	f-a	1
Result	2.14		1.42		2.00		2.14	
Vulnerability group	4		2		3		4	

Explanations: t-fl-through-flow lakes, l-loamy, s-sandy, a-f-agricultural-forest, f-forest, f-a-forest-agricultural.

TABLE-3(c,d)
ASSESSMENT OF CATCHMENT AS A SOURCE OF MATTER INPUT TO ANALYZED LAKES

Parameters	Chlop		Lubie		Wielgie	
	Value	Score	Value	Score	Value	Score
Lake coefficient	68.4	2	62.8	2	79.4	2
Balance type of lake	t-fl	3	t-fl	3	t-fl	3
Catchment morphometry: river network density, (m km^{-2})	0.1	1	0.2	1	0.1	1
Mean slope of the catchment (m km^{-2})	14.8	2	28.1	3	24.6	3
Areas without drainage (%)	6.9	3	8.4	3	7.3	3
Geological structure	l	0	s	3	l	0
Land use type	f-a	1	f-a	1	f-a	1
Result	1.57		2.28		1.85	
Vulnerability group	3		4		3	

Explanations: t-fl-through-flow lakes, l-loamy, s-sandy, a-f-agricultural-forest, f-forest, f-a-forest-agricultural.

TABLE-4
APPROXIMATE ANNUAL NITROGEN (N) AND PHOSPHORUS (P) LOADS (kg ha^{-1})
FROM SURFACE RUNOFF PER AREA OF THE ANALYZED LAKES

Catchment	Barlineckie		Glebokie		Lubiszewko		Przyleg		Chlop		Lubie		Wielgie	
	N	P	N	P	N	P	N	P	N	P	N	P	N	P
Direct	36.2	1.8	14.9	0.8	21.5	1.1	19.3	0.4	38.4	1.5	17.2	0.2	29.5	1.4

TABLE-5
ANNUAL UNIT PHOSPHORUS LOAD TO THE ANALYSED LAKES (mg m^{-2})
RESULTING FROM LAND USE TYPE IN THEIR CATCHMENTS

Type of phosphorus load input	Catchment						
	Barlineckie	Glebokie	Lubiszewko	Przyleg	Chlop	Lubie	Wielgie
Surface runoff	248.3	102.5	124.8	138.6	258.2	194.7	205.8
River input	113.8	54.9	69.4	71.8	52.8	142.6	85.3
Total	362.1	157.4	194.2	210.4	311.0	337.3	291.1

TABLE-6
RISK LEVELS OF THE ANALYZED LAKES

Phosphorus load (mg m^{-2})	Catchment						
	Barlineckie	Glebokie	Lubiszewko	Przyleg	Chlop	Lubie	Wielgie
Permissible load	219.6	85.2	123.5	102.8	142.7	94.8	164.9
Excessive load	439.2	170.4	247.0	295.6	295.1	183.7	279.5
Load resulting from the catchment land use	362.1	157.4	194.2	210.4	311.0	337.3	291.1
Risk level	II	II	II	II	III	III	III

determinants of these tanks may contribute to the deterioration of the quality of their waters (Tables 2 and 3).

Inference about the impact of the use of water reservoirs on the quality of their water was based primarily on identifying the risks excessive phosphorus supply from the confluence of the spell/Rune and tributary of the courses. The annual phosphorus load from the sources related to the use of the waters of the catchment area for trips into the lakes of the worst quality (Chlop, Lubie) exceeds the value of the cargo dangerous (Table-5). This is the evidence of the threat caused by the use of catchment area, of the receipt of the cargo of the phosphorus which causes deterioration of the quality of these lakes and a large likelihood of progress of their eutrophication. The pace of this process may be different, but the load of phosphorus greater than dangerous does not guarantee the maintenance of the trophic constant.

Explored lake belong to moderately susceptible to degradation (II category of vulnerability) (Table-2). The least resistant to degradation is lake Lubie, Przyleg, Wielgie (2 points). The resistance of the tank lowers the volume ratio to above all the length of the shoreline and the way the management of catchment areas (Table-2).

The largest loads, both nitrogen and phosphorus, are introduced by run-off from the direct catchment area to lakes Barlineckie, Chlop. Nitrogen and phosphorus load in the case of the direct catchment area of lake Osiek even 2-3 times exceeds those that reach the direct catchment area to lakes Glebokie, Lubie (Table-4).

By taking temporary charge of phosphorus getting into the major tributaries in summer for the average a year, extrapolated it for a period of 10 months (no freezing period) and was considered to be the value of the annual load transferred to Lake tributaries phosphorus. The size of this should be treated as an estimate, low and even the minimum value of the annual inflow of phosphorus, because courses in the calculation does not include the seasonal changes of concentration of phosphorus, which in summer, takes the smallest value and also changes the flow, for example. during the melt or the life and struggles of precipitation.

Total loads to tank boat ride surface phosphorus and its tributaries were considered annual phosphorus load from sources related to the use of catchment area (Table-5). The largest annual load of phosphorus from drainage area of lake Barlineckie, use to least-to lake Glebokie. Within a year the most phosphorus runoff into the lake with the area goes Chlop and courses-to Lubie (Table-5). The calculated phosphorus loads were brought to criterion[12] hydraulic model, adopted for the flow rate of the water of the lakes, taking into account the exchange of the year, and so were compared with calculated for cargo tanks and hazardous wastes under consideration limit. It is suggested that if the estimated annual phosphorus load associated with the use of catchment areas can be a potential threat to the lakes, even when given its minimum value that comes from its tributaries. Knowing the loads of phosphorus and dangerous, and going to the lakes as a result of the use of their catchment area defined categories of their risk according to Hillbricht-Ilkowskiej and Kayak[5] (Table-6).

In case of the load of phosphorous from lake Siecino annual use of the catchment area is greater than the acceptable, but less than dangerous (II category danger). The annual phosphorus load from source stated the use of catchment areas reaching the lakes M[1]kowarskiego and Osiek is larger (2-fold) from the dangerous for the tank (III category).

The calculated phosphorus loads were brought to criterion reported by Vollenweidera[12] hydraulic model, adopted for the flow rate of the water of the lakes, taking into account the exchange of the year and so were compared with calculated for cargo tanks and hazardous wastes under consideration limit. Thus, it is presumed that if the estimated annual phosphorus load associated with the use of catchment areas can be a potential threat to the lakes, even when given its minimum value that comes from its tributaries. Knowing the loads of phosphorus and dangerous and going to the lakes as a result of the use of their catchment area defined categories of their risk according to Hillbricht-Ilkowskiej and Kayak[5] (Table-6).

Only in the case of the load of phosphorous from lakes Barlineckie, Glebokie, Lubiszewko, Przyleg annual use of the catchment area is greater than the acceptable, but less than dangerous (II category danger). The annual phosphorus load from source stated the use of catchment areas reaching the lakes Chlop, Lubie and Wielgie is larger (2-fold) from the dangerous for the tank (III category) (Table-6).

REFERENCES

1. E. Bajkiewicz-Grabowska, The Circulation of Matter in River-Systems of Lake, Warsaw, Publisher, UW, p. 274 (2002).
2. P. Daniszewski, *Phys. Astron.*, **5**, 72 (2012).
3. P. Daniszewski, Physico-chemical properties of waters in Lake Barlineckie aerated by means of pulverising aerator. *The evolution of the geographical environment and nature protection in the industrialized and urbanized areas*, **44**, 16 (2012).
4. EEA, Corine land cover (2006), Copenhagen. www.eea.europa.eu.
5. Z. Hillbricht-Ilkowska and A. Kajak, in ed.: Parameters and Indicators Useful for Functional and Structural Changes in the Control of Lake Eutrophication process of ecosystems. In: Monitoring of Lake Ecosystems. Pr. collection. Ed. . Wroclaw, Ossolineum, pp. 23-46 (1986).
6. J.P. Jensen, E. Jeppensen, P. Kristensen, P.B. Christensen and M. Sondergaard, *Int. Rev. Gesamten Hydrobiol. Hydrograph.*, **77**, 29 (1992).
7. Z. Kajak, Hydrobiology, Inland Water Ecosystems, Bialystok, Warsaw, p. 326 (1994).
8. Z. Kajak, Hydrobiology-limnology. Inland water ecosystems, PWN, Warsaw, p. 355 (1998).
9. M. Kornas and A. Grzeskowiak, *Water-Environ.-Rural Areas*, **11**, 125 (2011).

10. R. Psenner, B. Boström, M. Dinka, K. Pettersson, R. Pucsko and M. Sager, *Arch. Hydrobiol. Beih. Ergebn. Limnol*., **30**, 83 (1988).
10. IMGW, Map of the Division of the Hydrographic Polish, Warsaw (2005).
11. H. Szyper and H. Zaniewska, Tourist Development Lakeland Areas, Warsaw, pp. 75-105 (1984).
12. R.A. Vollenweider, *Istytuto Italiano di Idrobiologia*, **33**, 53 (1976).
13. P. Daniszewski, *Phys. Astronomy*, **2**, 46 (2012).
14. P. Daniszewski, *Phys. Astronomy*, **2**, 35 (2012).
15. P. Daniszewski, *Phys. Astronomy*, **5**, 80 (2012).
16. Z. Kajak, *Ekol. Polut*., **31**, 495 (1983).
17. D. Kudelskiej, D. Cydzik and H. Soszka, Monitoring of the Basic Guidelines of the Lakes, Warsaw, p. 42 (1994).
18. G.E. Likens, Primary Production of Inland Aquatic Ecosystems. W: Primary Productivity of the Biosphere, New York, Springer Verlag, pp. 185-215 (1975).
19. J. Uchmañski and W. Szelegiewicz, *Ecol. Poland*, **36**, 285 (1988).
20. M. Giercuszkiewicz-Bajtlik, Forecasting Changes in Water Quality. Warsaw, IOS, p. 74 (1990).
21. J. Janczak, Atlas Polish Lakes, pp. 98-99 (1996).