Chapter 19

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The Impact of Water Quality on the Special Areas of Conservation (Natura 2000) Located in the River Narew and River Warta Valleys

1. Introduction

Beside the growing population, and thus also the increasing volume of waste waters, one of the basic reasons for deterioration of water quality is agriculture (Ilnicki 2004). Mineral fertilizers rich in nitrogen (N), potassium (K) and phosphorus (P) compounds affect the quality of surface water. The problems related to the deteriorating water quality are evidenced by the Council Directive 91/676/EEC of December 12, 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources, aimed at protection of human health as well as animal stock and water ecosystems.

Thus the processes that contribute most to water degradation include accelerated eutrophication of the inland surface waters, caused by high nitrogen and phosphorus concentrations (Wicherek 2010). By means of both superficial and subterranean run-off, the excess of those two elements in the soil reaches surface waters located at lower levels, thus causing their eutrophication (Zilberman 2000). The excess of the two elements enters surface waters via both point and area sources.

Therefore, water eutrophication and pollution are among the most frequently mentioned threats to the habitats of conservation within the Natura 2000 network. At the current stage of setting up of a consistent network of areas, aimed at conservation in Poland of continentally valuable habitats, possible actions should be considered that would help preserve or improve the quality of areas notified by Poland for protection as SAC.

The present authors have selected for analysis areas located in the river valleys of big lowland rivers, with habitats strongly dependent on water.

The reader should note that there are so far no Special Areas of Conservation in Poland. All SACs referred to in the publication have the status of Sites of

Community Importance. They have been notified by Poland as potential areas of conservation, and then accepted by the European Commission in 2007. They will probably be designated the Special Areas of Conservation in 2013 at the latest (Council Directive 92/43/EEC, 1992).

From the list of habitats contained in the Annex to the so-called Habitats Directive, the present authors have selected five habitats the condition of which depends, among other things, on water quality. They include: 91E0 Willow, poplar, alder and ash wetlands (*Salicetum albae, Populetum albae, Alnenion glutinosoincanae*, well-head alder swamps), 91F0 Oak, elm and ash riparian forests (*Ficario-Ulmetum*) as well as meadow and grassland habitats: 6410 Tall humid moor grasslands *(Molinion)*, 6430 Mountain *(Adenostylion alliariae)* and riverside grasslands *(Convolvuletalia sepium)* as well as 6510 Fresh low- and upland meadows utilized extensively *(Arrhenatherion elatioris)*. One of the selected habitats (91E0) is a priority habitat, i.e. one under the Community's special protection due to its natural range.

2. Description of the area under analysis

The area has been selected so as to analyze the possible impact of agricultural utilization of land included in the Natura 2000 network depending on its location in the territory of Poland. For analysis of the relationship between water quality and the selected habitats' condition, we chose two lowland rivers Narew and Warta together with their first order tributaries. The two rivers are similar in size but differ in terms of intensity of the basin and river utilization.

The river Narew is located in the Vistula basin as a right-bank tributary. The Narew is 484 kilometers long and runs mostly across Poland. However, the river has its source in Belarus. The stretch under analysis flows across the Podlaskie Province.

Due to its location, the Podlaskie Province, which includes two of the selected habitats, has been but relatively slightly transformed by anthropogenic impact. Together with the still preserved fragments of the original Białowieża Forest and the unique swamps in the river Biebrza valley and the Narew pool, it is an area of significant natural interest. The area's important economic elements include agriculture and food processing.

The other river under analysis is Warta. This third largest river in the territory of Poland is a right-bank tributary of the river Odra. It is over 800 kilometers long; its source is located in the Kraków-Częstochowa Upland, and its mouth in Kostrzyń on Odra.

A relatively long stretch of the Warta – as much as 370 kilometers – flows across the Wielkopolskie Province, where a major part of two Special Areas of Conservation discussed in this paper is located. The province is characterized by considerable industrialization and a dynamic economic growth.

Table 1 includes the basic meteorological data for the Greater Poland and Wielkopolskie provinces.

Table 1

Comparison of meteorological data for the Podlaskie and Wielkopolskie provinces (GUS 2010)

	Podlaskie province		Wielkopolskie province	
Weather stations	Białystok	Suwałki	Poznań	Kalisz
Annual average temperature [ºC]	7.2	6.9	9.3	9.1
Annual total precipitation [mm]	703	600	584	563
Average wind velocity [m/s]	2.5	3.4	3.5	3.7
Insolation [h]	1720	1797	1852	1943
Average cloud cover in oktas	5.3	5.2	5.2	5.5

In view of the nature of this analysis, the authors have decided to focus on the differences in the consumption of fertilizers expressed in pure components in the two discussed provinces. The annual average concentrations of the Narew and Warta eutrophication indices in 2000-2001 have been summarized in Table 3.

Table 2

Fertilizers consumption value expressed in kg of pure ingredient per square km for the Podlaskie and Wielkopolskie provinces (GUS 2009)

Fertilizers	Podlaskie province [kg/km^2]	Wielkopolskie province [kg/km^2]
nitrogen	25.72	54.74
phosphorus	12.67	21.81
potassium	14.38	27.71
organic	36.11	63.23
calcium	7.46	31.81
total	52.77	104.26

Table 3

Average annual concentration of eutrophication indicators in the Narew and Warta (2000 – 2001) (Danielewicz 2004)

Eutrophication indicators	Narew (cross-section Pułtusk)	Warta (cross-section Poznań)
Total phosphorus [mgP/dm^3]	0.18	0.17
Phosphate [mgPO4/dm^3]	0.24	0.28
Nitrate nitrogen [mgN/dm^3]	0.94	2.18
Total nitrogen [mgN/dm^3]	2.50	3.67
Chlorophyll a [mg/dm^3]	32.1	5.6

The symptoms of eutrophication, that is intense growth of the plankton algae, and thus a very high level of chlorophyll a, may in the case of the Narew result from the location of the measuring point. Namely, the Pułtusk section is located at the river's mouth, and may thus be affected by backwater.

As can be seen, the selected areas are highly differentiated. The Wielkopolskie Province area is to a much larger extent threatened with eutrophication caused by excessive presence of nitrogen and phosphorus compounds.

3. Description of the selected Special Areas of Conservation

The present authors have decided to select two habitats from among the Special Areas of Conservation located in the Narew basin: the Upper Narew Valley Refuge and the Biebrza Valley, as well as two areas located within the Warta basin: the Rogalin Warta Valley and the Noteć Valley (Fig. 1). The areas are located in the valleys of the rivers under analysis and their first order tributaries, and – as has been mentioned above – are subjected to different pressures resulting from water quality. The selected areas comprise habitats dependent on waters protected within the Natura 2000 network, including illow, poplar, alder and ash riparian forests, oak, elm and ash riparian forests as well as tall humid moor grasslands, mountain and riverside grasslands and extensively utilized lowland and mountain fresh meadows.

The first selected Special Area of Conservation, the "Upper Narew Valley Refuge" (PLH200010) has been approved as a Site of Community Importance in November 2007.

The designation of a refuge in that location was justified in view of the fact that the river valley after which it was named is among the best preserved and largest Central-European marshes. Due to the river's regular lagoons, the area is one of immense biological diversity. It comprises 10 habitats of those listed in Annex I to the Council Directive 92/43/EEC and is inhabited by 12 animal species of those listed in Annex II to that Directive.

The discussed area has 20,306.9 hectares. It comprises the Narew valley from the dam in Bondary to Suraż, as well as an adjacent pond complex fed from the rivulet Liza system. The meanders and old river beds found within the refuge are of exceptional landscape value. The area is mostly covered by rush communities – sedge communities and manna rushes, and by reed communities surrounding the old river basins. The discussed area also includes shrubs and willow afforestations. Forests cover but a small part of the valley. About 60% of its area is occupied by pastures and hay-growing meadows, and to a smaller extent by other areas in agricultural use. A considerable part of the "Upper Narew Valley Refuge" is already protected on the domestic scale, being located largely within the Protected Landscape Area of the Narew Valley (SDF "Ostoja w Dolinie Górnej Narwi", 2010).

The other area selected for analysis and located in the Podlaskie Province is the "Biebrza Valley" (PLH200008). The refuge of 121,206.2 hectares was approved as a Site of Community Importance in September 2007.

The Site comprises 16 habitats of those listed in Annex I to the Council Directive 92/43/EEC and is inhabited by 6 plant species of those listed in Annex II as well as 15 animal species of those listed also in Annex II to that Directive. Particularly noteworthy is the fact that the area comprises the RAMSAR refuge and the Biebrza National Park together with a part of its buffer zone. The Special Area of Conservation Biebrza Valley stretches from the state border to the locality of Niwkowo. It is inhabited by 42 bird species of those listed in Annex I to the Council Directive 79/409/EEC as well as 23 species of those listed in the Polish Red Book.

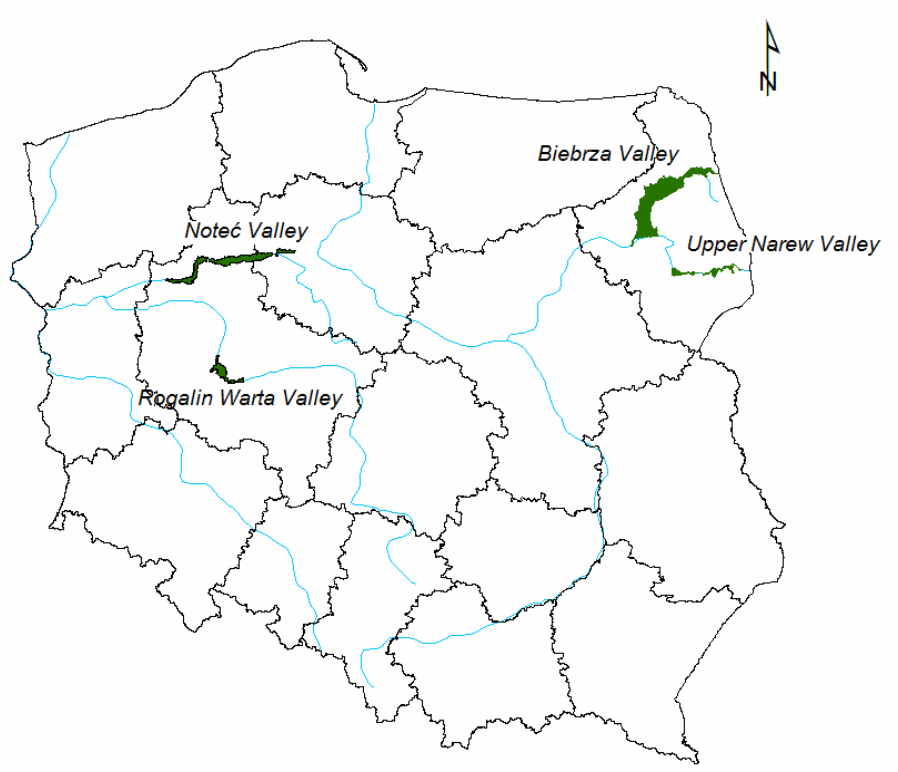

Fig. 1. Location of selected Special Areas of Conservation

The first of the areas selected from the Warta basin is the "Rogalin Warta Valley" (PLH300012). The refuge acquired the Site of Community Importance status in November 2007; it has the area of 14,753.6 hectares and comprises a fragment of the Warta proglacial stream valley south of Poznań.

Its unique nature is determined by numerous, well-preserved and strongly differentiated natural fluvial forms related to the river Warta's activity, such as old river beds, meadows or marshes, comprising 12 habitat types of those listed in Annex I to the Council Directive 92/43/EEC and inhabited by 6 animal species of those listed in Annex II to that Directive. Also that refuge is already protected to

a large extent under domestic legislation. Most of the refuge is located within the Rogalin Landscape Park, which includes two existing sanctuaries (Krajkowo and Goździk Siny in Grzybin) as well as a third planned sanctuary (of the Warta Old River Basin near Dąbrowa) (SDF "Rogalińska Dolina Warty", 2010).

The last area under analysis is the "Noteć Valley" (PLH300004). The refuge was approved as a Site of Community Importance also in November 2007. The Site has the area of 50,532.0 hectares and comprises 16 protected habitat types of those listed in Annex I to the Council Directive 92/43/EEC. It is inhabited by 7 animal species of those listed in Annex II to the Council Directive 92/43/EEC as well as 1 plant species of those listed in that same Annex.

The discussed Site of Community Importance comprises a fragment of the Noteć valley from Wieleń to Bydgoszcz. A large part of the refuge is taken by lowlands, with fragments of lagoon meadows and reed communities. Most of the refuge is located within the Protected Landscape Area Noteć Valley (131,000.0 hectares; 1989) and comprises 4 sanctuaries: Czapliniec Kuźnicki (5.45 hectares; 1988), Łąki Ślesińskie (42.0 hectares; 1975), Kruszyn (73.0 hectares; 1997) and Skarpy Ślesińskie (14.0 hectares; 1999). (SDF "Dolina Noteci", 2010).

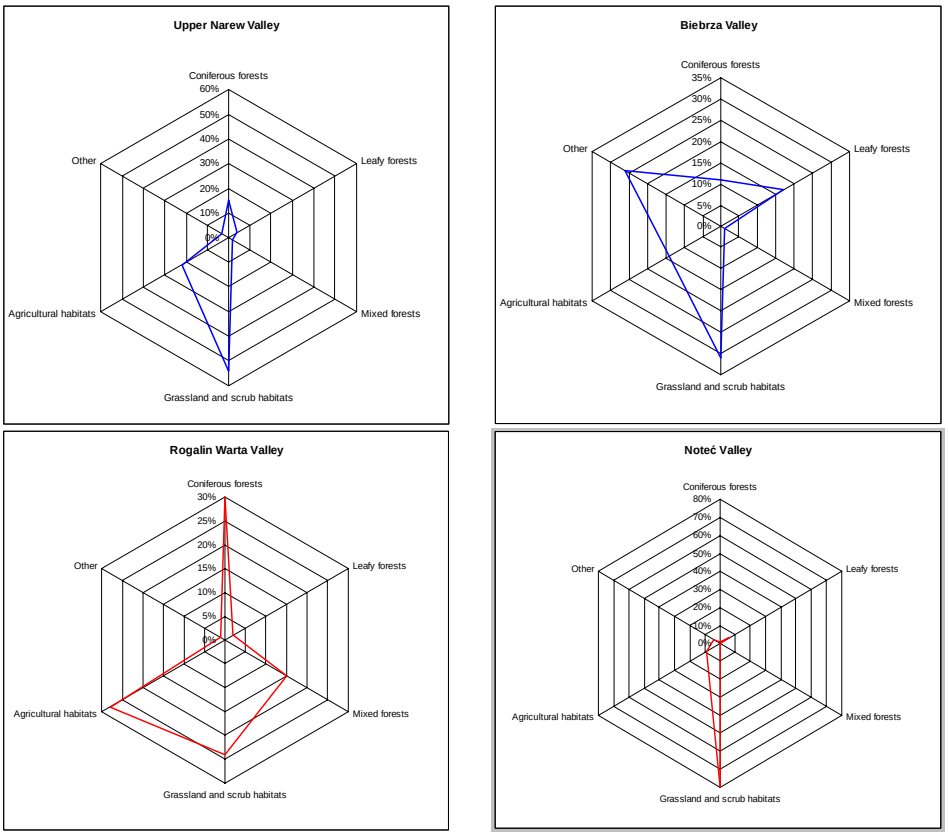

Fig. 2. Comparative analysis of utilization of the selected Special Areas of Conservation (Standard Data Form, 2010)

As can be noticed, areas located in the Podlaskie Province differ from refuges located in north-western Poland in terms of utilization. The refuge located in the Biebrza valley has a big proportion of utilization classified as "other" and includes peat bogs, swamps and inland waters. The Rogalin Warta Valley is the most afforested area, while the biggest number of meadow and scrub habitats can be found in the Warta Refuge.

The present article focuses on the potential impact of agriculture on the quality of water and water-dependent habitats. Fig. 2 shows the comparative analysis of utilization of the selected Sites of Community Importance. As follows from analysis of the graphs, the area most threatened with agricultural impact is the Rogalin Warta Valley.

On the basis of data on utilization, fertilizer consumption and eutrophication indices concentration, it can be concluded that habitats located within the Warta basin are to a bigger extent threatened with pressures related to agricultural utilization.

4. Description of the selected habitats

From the list of habitats contained in the so-called Habitats Directive, the present authors selected five habitats strongly dependent on water quality and found within the selected Sites of Community Importance in different conditions. The selected habitats include forests: 91E0 Willow, poplar, alder and ash wetlands (*Salicetum albae*, *Populetum albae*, *Alnenion glutino-soincanae*, well-head alder swamps), 91F0 Oak, elm and ash riparian forests (*Ficario-Ulmetum*) as well as meadow and grassland habitats: 6410 Tall humid moor grasslands *(Molinion)*, 6430 Mountain *(Adenostylion alliariae)* and riverside grasslands *(Convolvuletalia sepium)* as well as 6510 Fresh low- and upland meadows utilized extensively *(Arrhenatherion elatioris).*

The priority habitat of "willow, poplar, alder and ash wetlands" (91E0) is defined as "riverside forests: old alder groves, alder, ash, white and crack willow as well as white and black poplar forests" (Borsiak 2004).

The wetlands included in that habitat grow on river-flooded soil with high groundwater levels. The areas are usually classified as post-swamp or alluvial. The relationship of those ecosystems with running water and river valleys is stressed. They can be found all over Poland, and also in most of the Natura 2000 habitats in the country. It is also stressed that the discussed habitat affects water retention and operation of the ecological corridors within the hydrographic network (Borsiak, 2004). In view of the fact that the habitat under analysis includes several forest stand types that differ significantly from one another, it has been divided into the following subtypes: 91E0-1 (willow wetland), 91E0-2 (poplar wetland), 91E0-3 (lowland ash and alder wetland), 91E0-4 (well-head lowland ash forests), 91E0-5 (foothill ash wetland), 91E0-6 (riverside mountain alder grove) and 91E0-7 (swampy mountain alder grove).

The basic threats to that habitat include water quality changes leading to eutrophication, water volume changes, as well as hydrotechnical structures.

The next habitat, "oak, elm and ash riparian forests" (91F0) is defined as "wet oak, elm and ash forests dependent on habitats occasionally flooded with river waters or influenced by periodical flows of surface waters or moving ground waters" (Danielewicz 2004). The habitats are also found all over Poland, but are less frequent than e.g. ash and alder wetlands (91E0). This habitat type is also dependent on running waters, but can be found in somewhat wetter areas (Borsiak, 2004).

The discussed habitat can be found in periodically flooded areas of big river valleys, in wet depressions outside such valleys, in fragments of lake terraces, in the valleys of small lowland rivers and streams, and also in troughs with periodical surface flow.

In the Polish "oak, elm and ash forests", oak prevails. Ash and elm can be found less often as the prevalent species. The ground cover comprises eutrophic forest species. Usually, no biogenic species can be found in its composition (Danielewicz 2004).

Two subtypes of the analyzed habitat have been distinguished: 91F0-1 (elm and ash wetland typical of occasionally flooded areas of big river valleys) and 91F0-2 (elm and ash wetland dependent on moving waters not causing surface floods).

To the above habitats, the main threat is a change in water volume, but also quality; forestry; and hydrotechnical structures.

The further three habitats selected for further analysis are meadows and grasslands: 6410 Tall humid moor grasslands *(Molinion)*, 6430 Mountain *(Adenostylion alliariae)* and riverside grasslands *(Convolvuletalia sepium)*, 6510 Fresh low- and upland meadows utilized extensively *(Arrhenatherion elatioris)*.

The "tall humid moor grasslands *(Molinion)*" (6410) are defined as "meadows, rich in species and humid or periodically dry, inhabited i.a. by moor grass *Molinia caerulea*, that develop on organogenetic and mineral soils from highly acidic to alkaline, with variable ground water levels" (Kącik 2004). Due to its big floristic diversity, this habitat type is regarded as one of the most valuable semi-natural habitats resulting from extensive farming. This type of meadows can be found all over Poland.

The habitat has a very broad ecological amplitude. It may emerge on both rich and mesotrophic, oligotrophic, humid and fresh subsoil. Its specific feature is the ground water level that changes during the year and constitutes the basic element to differentiate and determine the development of specific vegetation within the habitat.

Two subtypes of the tall humid moor grasslands can be distinguished: 6410–1 (selinum and moor meadows *Selino carvifoliae-Molinietum)* and 6410–2 (rush and moor meadows *Junco-Molinietum*) (Kącik 2004).

Mentioned among the main threats to that habitat are changes in their utilization and management, as well as changes in the water relations.

The "mountain *(Adenostylion alliariae)* and riverside *(Convolvuletalia sepium)* grasslands" 6430 are defined as comprising "natural, hydrophilous and permanent grasslands in uplands and plateaux (class *Betulo-Adenostyletea*) and nitrophilous and fringe herb and vine communities along lowland water-courses (class *Galio-Urticenea*)" (Mróz 2004). The fringe communities can be found on the banks of big lowland rivers (such as Warta and Narew) or lakes and ponds. The areas are flooded permanently or periodically. The veil communities are a natural transition from rush communities (adjacent on water) and willow wetlands protected within the Natura 2000 program, together making up a dense spatial complex.

The following subtypes can be distinguished: 6430-1 (subalpine and mountain grasslands), 6430-2 (stream bank butterbur grasslands) and 6430-3 (lowland riverside fringe communities). The present authors focus on the latter subtype.

The basic threats to that subtype include invasion of species of foreign origin, intensification of agriculture and reduction of the riverside alluvium areas, as well as any works leading to riverbed stabilization (Mróz 2004).

The last of the selected habitats – the "fresh low- and upland meadows utilized extensively" *(Arrhenatherion elatioris)"* (6510) – is defined as "anthropogenic low- and upland fresh hay-growing meadows, highly productive and rich in vegetation" (Kucharski 2004). The discussed habitat can be found in river valleys, growing in areas located outside the river flood.

Four subtypes of the analyzed habitat have been distinguished: 6510-1 (rye-grass meadows (oat grass) (*Arrhenatheretum elatioris* 38.222)), 6510-2 (meadows with meadow grass and red fescue (*Poa pratensis-Festuca rubra* community)), 6510-3 (subalpine sword lily and bent grass meadow (*Gladiolo-Agrostietum capillaris* 38.2331)) and 6510-4 (stenothermal Pieniny meadow (*Anthyllidi-Trifolietum montani* 38.2332)).

The subtypes of rye-grass meadows and meadows with meadow grass and red fescue are highly sensitive to changes in fertility, humidity and utilization. Those very factors pose the biggest threat to habitats of that type.

5. Methodology

The water quality evaluation used in the study was based on the Ordinance of the Minister of the Environment pertaining to classification of the condition of surface water bodies of 2008 (Rozporządzenie 2008). The Ordinance defines the classification of:

- physico-chemical, biological and hydromorphological elements, on the basis of their respective quality indices, for individual categories of uniform parts of different types of surface waters,
- ecological condition of the surface water bodies in natural water-courses, lakes or other natural reservoirs, transition and in shore waters, with due consideration to the classification of elements referred to under "a",

- ecological potential of artificial surface water bodies and much altered of surface water bodies, with due consideration to the classification of elements referred to under "a",
- chemical condition of surface water bodies.

The ecological condition is rated on the basis of biological, hydromorphological and physico-chemical elements on a five-point scale.

The data on the ecological condition of waters, used in the present study, has been gathered in a survey carried out within the State Environmental Monitoring. For the purpose of comparisons, the present authors have attributed numerical values to all of the conditions. Very good condition has been given the score of 5, good condition – the score of 4, moderate condition – 3, poor condition – 2, and bad condition – 1.

Chemical condition is classified on the basis of analysis of the measurements of pollutants. The analysis is based on comparison of the obtained measurements with the limits for individual surface water categories as specified in Annex 8 to the Ordinance.

It is assumed that the chemical condition of surface water is good if the concentrations of individual quality parameters of the water quality indices stay below the limits for individual surface water categories as specified in Annex 8 to the Ordinance. Water that fails to meet the requirements is assumed to be below the good chemical condition.

The data on the chemical condition of waters, used in the present study, has been gathered in a survey carried out within the State Environmental Monitoring. As in the case of the ecological condition, a scale has been used where 1 stands for good condition, and 0 for any condition below good. In the case of both ecological and chemical condition, the evaluation of water quality was calculated as the arithmetical mean of measurements taken at measurement points within the specific SAC or in its close vicinity.

A similar approach, that is utilization of public data followed by rating, was used to evaluate the state of conservation of the habitats. The data on which the evaluation has been based was obtained from the Standard Data Forms for the selected refuges. The evaluation includes:

- the degree of structure conservation (rated on a scale from I – excellent to III – average or degraded),
- the degree of function conservation (rated on a scale from I – excellent to III – average or poor conservation prospects),
- the possibility of re-naturization / reconstruction (rated on a scale from I – easy to III – difficult or impossible) (Rojek, 2010).

The ultimate conservation rating is the resultant of the aforementioned components expressed with letters, where

- A stands for excellent
- B stands for good
- C stands for significant

If the habitat fails to meet the requirements, its quality can be evaluated as D – insignificant.

To evaluate the quality of the selected habitats, the authors have used a score system. The habitat conservation rating expressed with letters in the Standard Data Forms has been converted into a scoring scale. Thus the score of 6 stood for excellent conservation, 4 – for good conservation, 2 – for significant and 0 for insignificant conservation.

6. Results

6.1. Evaluation of water quality

When evaluating water quality of the area PLH200010 – the Upper Narew Valley Refuge – five measurement points located within different stretches of the river Narew and its tributaries were taken into consideration. The locations of the measurement points are shown in Fig. 3, and the findings are summarized in Table 4. The points highlighted in gray are not taken into consideration because they are situated below SAC.

Table 4

Evaluation of water quality in the Upper Narew Valley (WIOŚ Białystok, 2010)

No.	Location	River	Evaluation of ecological condition	Evaluation of chemical condition
1	Suraż	Narew	moderate	below good
2	River mouth profile	Strabelka	moderate	-
3	Chraboły	Orlanka	moderate	-
4	Ploski	Narew	moderate	-
5	Bondary	Narew	moderate	-

In the case of the Bondary profile, the evaluation of susceptibility to eutrophication in 2009 revealed that the chlorophyll "a" limit, which is the lower limit of eutrophication, was exceeded.

In the case of the refuge PLH200008 – Biebrza Valley, surveyed within the State Environmental Monitoring by the Provincial Environment Protection Inspectorate in Białystok, measurements at seventeen measurement points have been taken into consideration. Their locations are shown in Fig. 4, and the findings are summarized in Table 5.

Within evaluation of susceptibility to eutrophication, limits were exceeded at the following points: the mouth in the town of Ostrowo, the town of Goniądz, Łaziuki, Wity and the mouth in Gać.

The refuges located within the Warta basin were surveyed within the State Environmental Monitoring by the Provincial Environment Protection Inspectorate

in Poznań and the Provincial Environment Protection Inspectorate in Bydgoszcz. The findings of those measurements are summarized in Table 6 and Table 7.

Three rivers located in the Wielkopolskie Province were surveyed for water suitability for fish. In all cases, the criteria were not met due to excess of general phosphorus and nitrites. The situation was similar in the Kujawsko-Pomorskie Province.

Table 5

Evaluation of water quality in Biebrza Valley (WIOŚ Białystok, 2010)

No.	Location	River	Evaluation of ecological condition	Evaluation of chemical condition
1	Burzyn-Rutkowskie	Biebrza	moderate	below good
2	Dobarz	Kosódka	moderate	-
3	Mouth in Osowiec town	Kropiwna	moderate	-
4	Strękowa Góra	Narew	moderate	below good
5	Osowiec stage-recorder	Biebrza	moderate	-
6	Bronowo	Łojewek	moderate	-
7	Karpowicze stage-recorder	Brzozówka	moderate	-
8	Stara Kamienna	Kamienna	moderate	-
9	Lipsk	Biebrza	moderate	-
10	Goniądz	Czarna Struga	moderate	-
11	Kuligi	Jegrznia	moderate	good
12	Polkowo-Zwierzyniec	Netta	moderate	good
13	Osowiec	Ełk	moderate	below good

Table 6

Evaluation of water quality in Rogalin Warta Valley (WIOŚ Poznań, 2010)

No.	Location	River	Evaluation of ecological condition	Evaluation of chemical condition
1	Kępa Wielka	Maskawa	bad	below good
2	Krajkowo	Warta	-	-
3	Śrem	Pisząca	moderate	-
4	Mosina	Kanał Mosiński	moderate	below good
5	Wiórek	Warta	poor	good

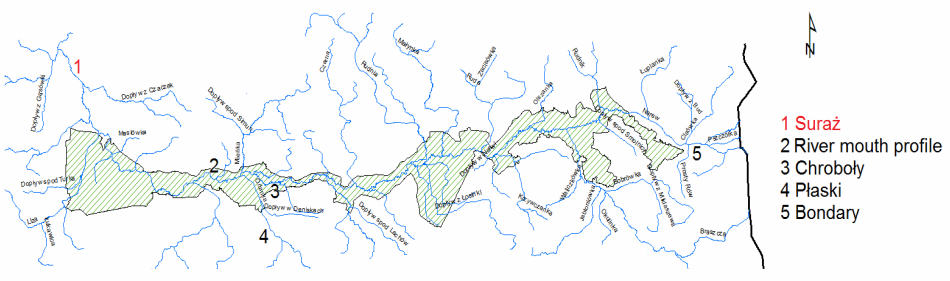

Fig. 3. Locations of measurement points in Upper Narew Valley

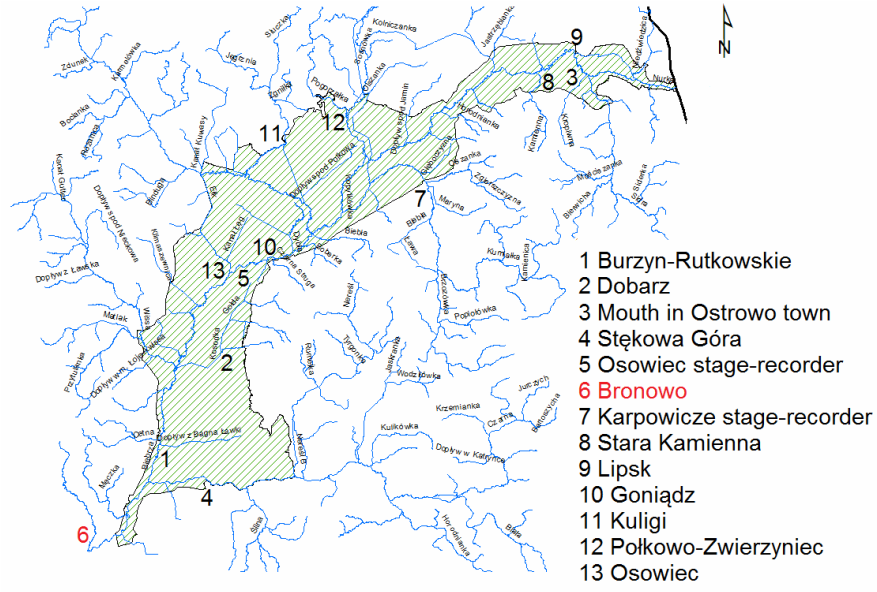

Fig. 4. Locations of study sites – Biebrza Valley

Table 7

Evaluation of water quality in Noteć Valley (WIOŚ Poznań, 2010, WIOŚ Bydgoszcz, 2010)

No.	Location	River	Evaluation of ecological condition	Evaluation of chemical condition
1	Drawski Młyn	Noteć	poor	-
2	Herburtowo	Bukówka	moderate	-
3	Ujście	Gwda	poor	below good
4	Ujście stage-recorder	Noteć	bad	below good
5	Nowy Dwór	Kcynka	poor	-
6	Osiek nad Notecią	Łobżonka	bad	-
7	Chobielin Młyn	Noteć	moderate	good
8	Łochowo	Górny Kanał Notecki	-	good

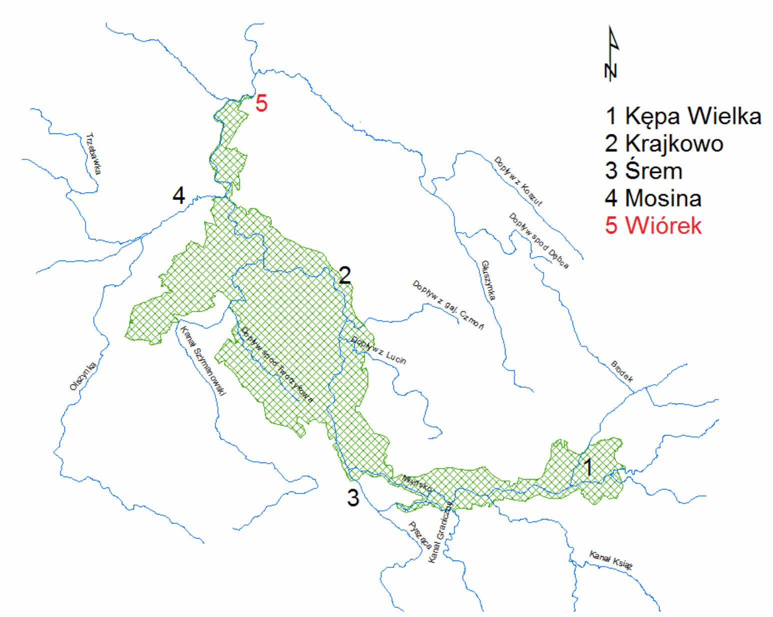

Fig. 5. Locations of study sites – Rogalin Warta Valley

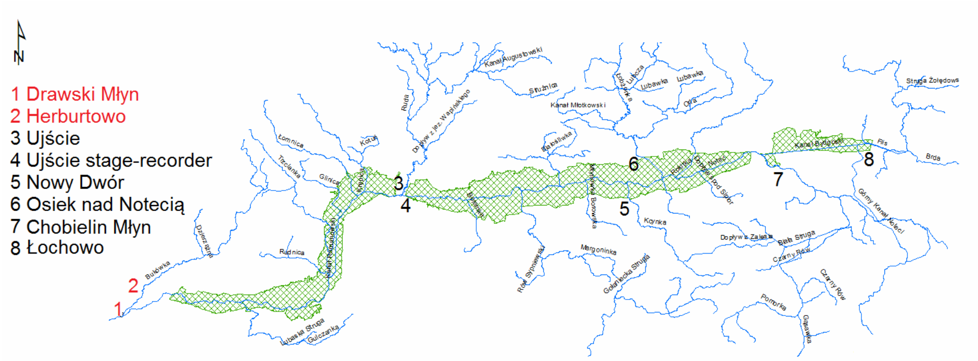

Fig. 6. Locations of study sites – Noteć Valley

Table 8 summarizes the results of evaluation of the ecological and chemical condition on the basis of the scale used in the study.

As follows from the above findings, water quality within the refuges located in the Warta basin is inferior in terms of ecological condition to water quality in the Special Areas of Conservation within the Narew basin.

Table 8

Evaluation of the ecological and chemical condition in chosen Sites of Community Importance

SAC	Evaluation of ecological condition	Evaluation of chemical condition
Upper Narew Valley	3,00 (4*)	0,00 (0*)
Biebrza Valley	3,00 (12*)	0,40 (5*)
Rogalin Warta Valley	2,66 (3*)	0,00 (2*)
Noteć Valley	1,80 (5*)	0,50 (4*)

* - number of points used for calculation

6.2. Evaluation of quality of the habitats

The results of evaluation of the quality of selected habitats (that is, the habitat's conservation as stated in the Standard Data Forms) are shown in Fig. 7 and Table 9.

Table 9 summarizes the results of comparison of habitat quality in Narew and Warta basins. The scores shown are average values for all chosen habitats. The detailed method of giving scores to individual quality levels is described in "Methodology" section.

Table 9

Comparison of habitat quality in Narew and Warta basins

Habitat	Narew	Warta
6410	3	3
6340	3	5
6510	3	4
91E0	3	2
91F0	1	4

The table shows that there is a difference in habitat quality on Narew and Warta rivers as well as their main tributaries. Water-dependent habitats on Warta river are in general better preserved than those on Narew.

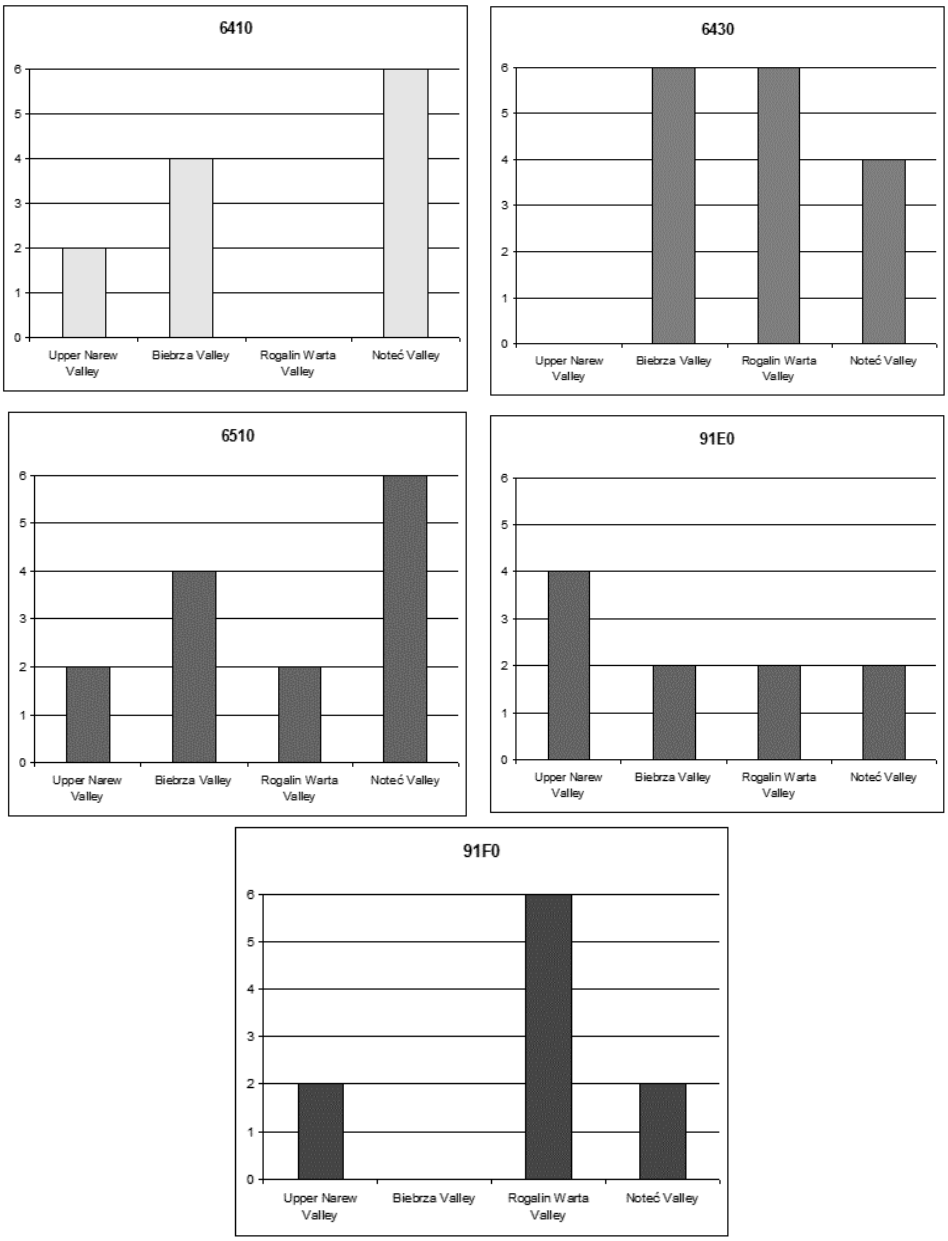

Fig. 7. Preservation level of habitats in chosen Special Areas of Conservation

7. Conclusions

The analysis failed to demonstrate explicit interdependence between water quality of the main water-course running across the refuges and the condition of habitats dependent on those waters. In the case of the river Narew, despite the better ecological condition of the waters, conservation of three of the five studied habitats was inferior to that found in the Warta basin. In this case, it can be assumed that the chemical condition was decisive. As regards the habitat 91E0, it is better preserved in areas in a better ecological condition. Instead, the conservation of the habitat 6410 is the same in both areas under analysis.

As follows from the present paper, the stocktaking data of habitats included in the Natura 2000 network fail to provide the grounds for an explicit statement that surface water quality, increased eutrophication included, significantly affects the habitat's quality. The present analysis of the habitats' conservation covers a single moment in time. The reason for this approach is a lack of generally available data mainly on the habitats' condition (evaluated in Poland on a single occasion only) as well as water quality data based on uniform data collection methodology. The Surface Waters Monitoring System underwent significant changes and is still being modified. The Ordinance that provided the basis for the evaluation of Poland's water resources presented in this article has by now been replaced by the Ordinance of the Minister of the Environment pertaining to classification of the ecological condition, ecological potential and chemical condition of surface water bodies of July 22, 2009.

In the opinion of the present authors, monitoring of hydrogenic habitats with more frequent surveys of their conservation, as well as a detailed study of the impact of nitrogen and phosphorus on water dependent habitats, would considerably contribute to improved protection of the naturally valuable areas on the European scale.

Besides, also the possibility of monitoring the impact on individual habitats of surface waters from the immediate refuge's basin should be considered.

Further research into the habitats under analysis will pertain to changes of the river regime and their impact on conservation.

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