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Forms of nature protection occurring on artificial water reservoirs in Poland

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ABSTRACT

In Europe, alongside the preservation of cultural heritage, environmental protection is becoming increasingly important, especially in the context of the growing climate crisis and the progressive degradation of ecosystems. Nature is a common national and international good that requires effective protective measures. One example of a systemic solution for nature conservation is the Natura 2000 network of protected areas, established on the basis of European Union directives. The network aims to preserve valuable and endangered natural habitats and species of flora and fauna that are crucial for the preservation of biodiversity on a continental scale. Despite the widespread belief that civilisation's development generates pressure on the natural environment and disrupts the ecological balance, the potential for positive human intervention is also increasingly being emphasised. Technological progress and economic changes can enable the revitalisation of degraded areas and the creation of new habitats conducive to the restoration of functioning ecosystems. In light of the above, the aim of this article is to analyse Polish areas included in the Natura 2000 network that have been designated on artificial water reservoirs or in their immediate vicinity.

Keywords: water, artificial water reservoirs, Natura 2000 network.

INTRODUCTION

Water is a fundamental component of the biosphere, essential for the life of all organisms. Its unique physical and chemical properties and widespread occurrence make it the basis for the functioning of ecosystems. For humans, it is the basis of everyday life – it is essential for domestic and economic purposes, as well as in many industrial processes (Ochmańska et al., 2025).

Although water covers a significant part of the Earth's surface, freshwater resources are limited and unevenly distributed. Due to its geographical location, Poland is one of the countries with relatively small water resources compared to other European countries (Ziernicka-Wojtaszek and Kopcińska, 2020). In addition, during the growing season, precipitation is lower than evapotranspiration, which exacerbates the water deficit (Kaca, 2012). In response to these challenges, humans take measures to store water, including the construction of artificial reservoirs. The dams that form these reservoirs become key elements of infrastructure, enabling the survival and development of civilisation in conditions of limited water resources (Żbikowski and Żelazo, 1993; Dmitruk et al., 2023).Hydropower is undoubtedly one of the most environmentally friendly methods of generating electricity. Hydropower plants, as installations that use the natural movement of water, do not emit harmful substances into the atmosphere, and their operation – when appropriate standards are maintained – is consistent with the principles of environmental protection (Vermaak et al., 2024).

One of the key elements of hydroelectric power plant operation is the creation of reservoirs, which not only collect water for energy purposes, but also fulfil a number of important environmental functions (Lach, 2019). These reservoirs help maintain adequate groundwater levels, mitigate the effects of high water levels and prevent

flooding, thereby minimising potential damage to the natural environment (Batalla, 2004).

The primary task of dams is to create reservoirs that allow for the retention of excess runoff water, which can then be used during periods of drought (Graf, 1999). Without this infrastructure, a stable water supply for the population and industry – especially in the face of seasonal fluctuations in flow – would be significantly more difficult (Zhang and Tian, 2025). Power plants built at dams enable the use of the mechanical energy of water to produce electricity in a sustainable and environmentally friendly manner (Othman et al., 2025). Water, as a renewable resource, is inexhaustible and does not generate pollution, making it one of the pillars of the green energy transition (Luis et al., 2013). An additional advantage of dam construction is that it supports the development of tourism and recreation around water reservoirs, which in turn contributes to the creation of new jobs and the revitalisation of local communities (Bojarski et al., 2005; Varolgüneş et al., 2025).

However, it should be remembered that the construction of dams and reservoirs has an impact on the environment. Such investments are inherently associated with the transformation of the natural landscape and interference with aquatic and terrestrial ecosystems (Binder and Dziewiański, 1998; de Barcelos et al., 2024). There is a widespread opinion that such structures conflict with the principles of nature conservation and sustainable development (ICOLD Declaration, 1996). The Natura 2000 network is the newest form of nature conservation in Poland (Nature Conservation Act of April 16, 2004). Unlike traditional forms of nature conservation, Natura 2000 assumes the harmonious coexistence of humans and nature, rather than its complete exclusion from use (Niewiadomski, 2013).

It was created as part of the European Ecological Network, whose primary goal is to protect endangered species and specific types of habitats, as well as to preserve biodiversity throughout Europe (Paixão, et al., 2009; Hemp et al., 2022. The aim of this paper is to show, using the example of Polish Natura 2000 sites, that the construction of artificial water reservoirs can be an important element of environmental protection.

MATERIALS AND METHODS

The aim of the study is to compile a list of Polish areas belonging to the Natura 2000 network located on artificial water reservoirs. The analysis covered 137 such sites located in Poland. Using data from the European Environment Agency database (https://www.eea.europa.eu/en) and from the General Directorate for Environmental Protection in Poland (https://geoserwis.gdos.gov.pl/mapy/), their links with areas protected under the Natura 2000 network were identified. In particular, the occurrence of two types of protected areas was checked:

- special protection areas (SPAs),
- special areas of conservation (SACs).

Figure 1 shows the number of artificial water reservoirs in individual voivodeship in accordance with the administrative division in force in Poland. Figure 1 shows that the largest number of reservoirs is located in the Śląskie Voivodeship. There are 27 of them, which accounts for 19.71% of all reservoirs in Poland. The next places are taken by the Wielkopolskie Voivodeship (19 reservoirs) and the Świętokrzyskie Voivodeship (14 reservoirs). In the remaining voivodeship, the number of reservoirs does not exceed 10% of the total. The smallest number, only two reservoirs, are located in the Warmińsko-Mazurskie Voivodeship. These are Lake Pierzchalskie in the municipality of Płoskinia and the Ruda Reservoir in the municipality of Iłowo-Osada.

RESULTS

SPAs and SACs are designated on the basis of different criteria, but in some cases they may overlap completely or partially, which is why this article divides artificial water reservoirs into SPAs and SACs.

Figure 2 shows the percentage of special protection areas for birds established on or near artificial water water reservoirs in individual voivodeship. When analysing the occurrence of SPAs for birds in individual voivodeships, it can be seen that they are predominantly located in northern Poland.

In the Wielkopolska Voivodeship, 8 out of 19 reservoirs are listed as SPAs. These are: Lake Wielkie in the municipality of Chrzypsko Wielkie (the "Puszcza Notecka" area), Lake Bąd in the municipality of Wieleń (the "Dolina Miały" area), Lake Mileczki in the municipality of Wieleń (the "Puszcza Notecka" area), Lake Górne in the municipality of Wieleń (the

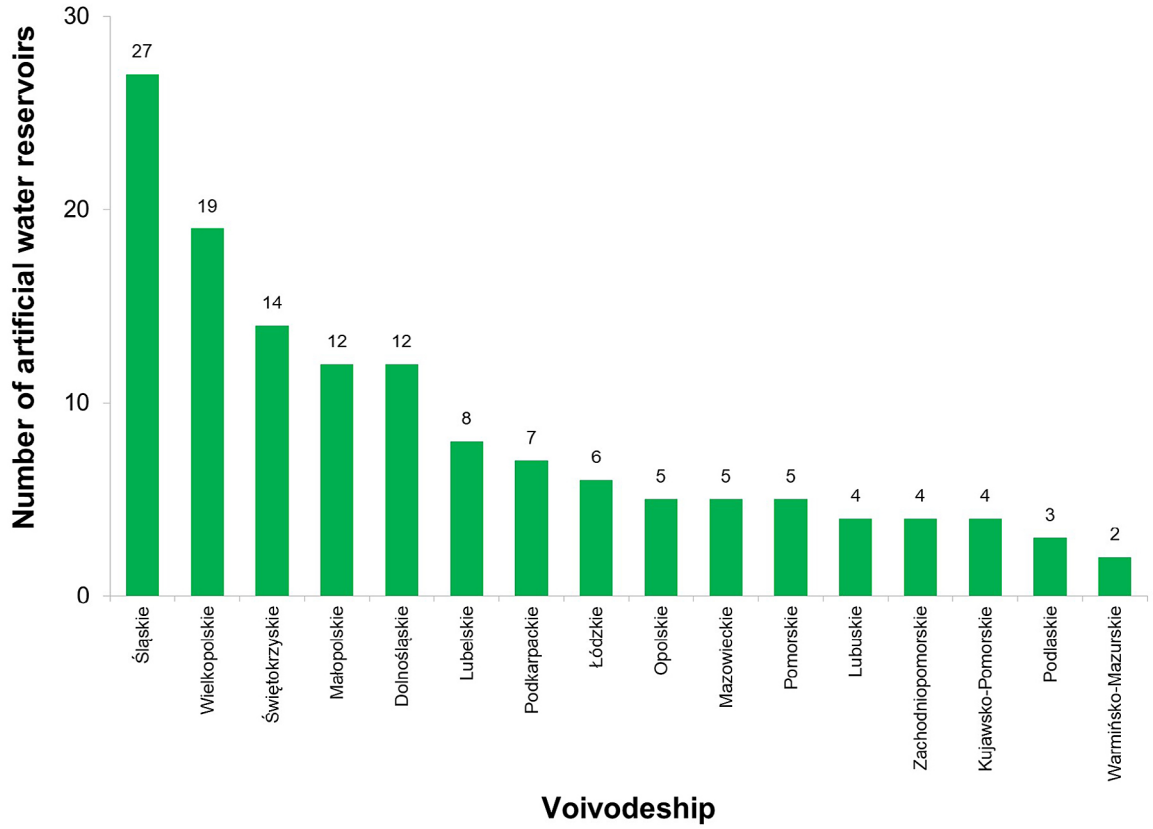

Figure 1. Number of artificial water reservoirs in Poland by voivodeship

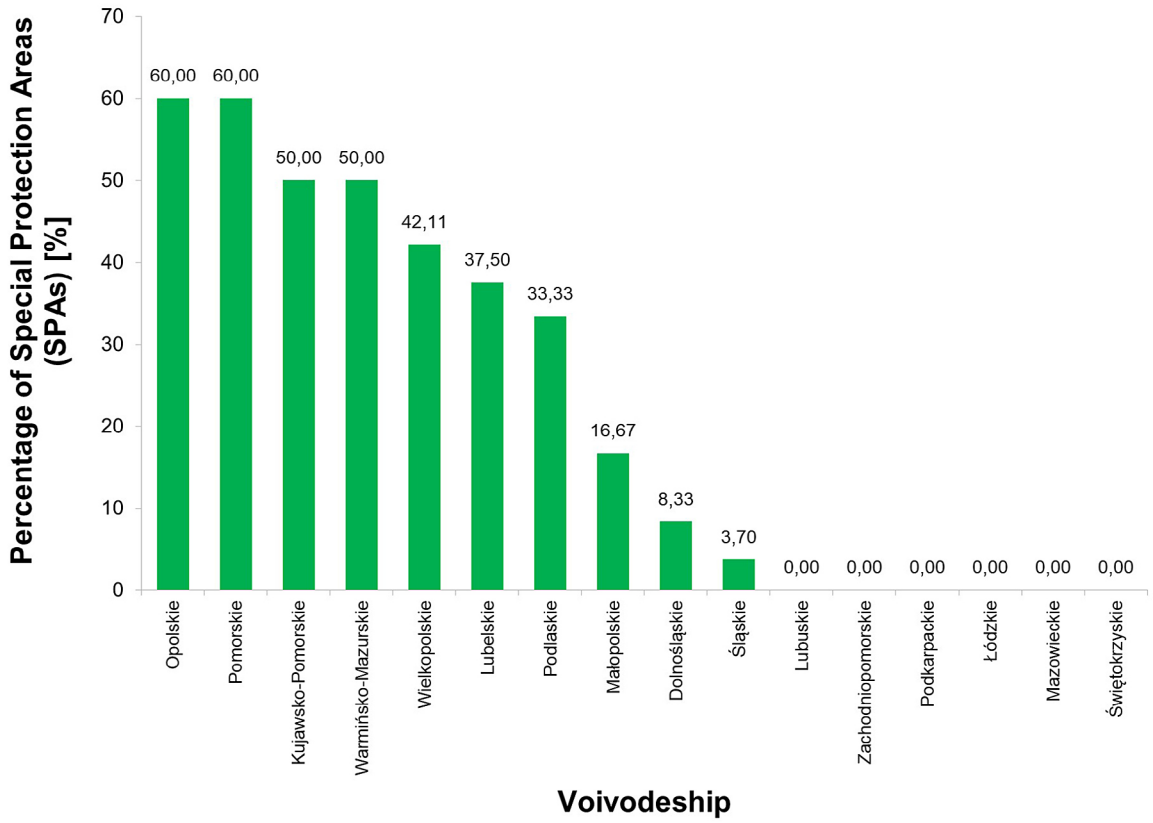

Figure 2. Percentage of special protection areas (SPAs) established in Poland on or near artificial water reservoirs

"Puszcza Notecka" area), Lake Wonieskie in the municipality of Śmigiel (the "Zbiornik Wonieść" area), Dobrzyckie Lake in the municipality of Szydłowo (the "Puszcza nad Gwdą" area), Małe Lake in the municipality of Pobiedziska (the "Ostoja Międzychodzko-Sierakowska" area) and the Jeziorsko Reservoir on the Warta River (the "Zbiornik Jeziorsko" area).

In the Pomorskie Voivodeship, three out of five artificial reservoirs are included in the SPAs list. These are the Zapora Reservoir (Mylof) on the Brda River in the municipality of Czersk (the "Bory Tucholskie" area), the Cicha Woda Reservoir in the municipality of Borzytuchom (the "Dolina Słupi" area) and Lake Gostkowskie in the municipality of Dębnica Kaszubska (the "Dolina Słupi" area). In the Kujawsko-Pomorskie Voivodeship, two of the four artificial reservoirs are on the SPAs list. These are Lake Gródkowskie in the Świecie County (the "Bory Tucholskie" area) and Lake Żurskie in the Osie municipality (the "Bory Tucholskie" area).

In the Warmińsko-Mazurskie Voivodeship, one of the two artificial reservoirs is included in the SPA list – Lake Pierzchalskie in the municipality of Płoskinia (the "Rzeka Pasłęka" area). In the Opolskie Voivodeship, three of the five artificial reservoirs are on the Special Protection Areas list. These are Lake Nyskie in the immediate vicinity of the district town of Nysa (the "Zbiornik Nyski" area), Lake Otmuchowskie above the town of Otmuchów (the "Zbiornik Otmuchowski" area), and Lake Turawskie in the municipality of Turawa (the "Zbiornik Turawa" area). There are three reservoirs in the Lubelskie Voivodeship included in the SPAs list. These are the Nielisz Reservoir in the Zamość County (the "Ostoja Nieliska" area), Mosty in the Podedwórze commune (the "Uroczysko Mosty-Zahajki" area) and Siemień Pond in the Parczew commune (the "Dolina Tyśmienicy" area).

In the Podlaskie Voivodeship, one of the three artificial reservoirs is included in the SPA list. It is the Zarzeczany Reservoir in the municipality of Gródek (the "Ostoja Knyszyńska" area). In other voivodeships, the number of artificial reservoirs where special bird protection areas (SPAs) have been established does not exceed 20%.

In the Małopolskie Voivodeship, there are two reservoirs included in the SPAs list. These are Lake Klimkowskie on the Ropa River (the "Beskid Niski" area) and the Sromowce Reservoir on the Dunajec River (the "Pieniny" area).

In the Dolnośląskie Voivodeship, out of twelve artificial reservoirs, only one is included in the SPA list – Lake Mietkowskie on the Bystrzyca

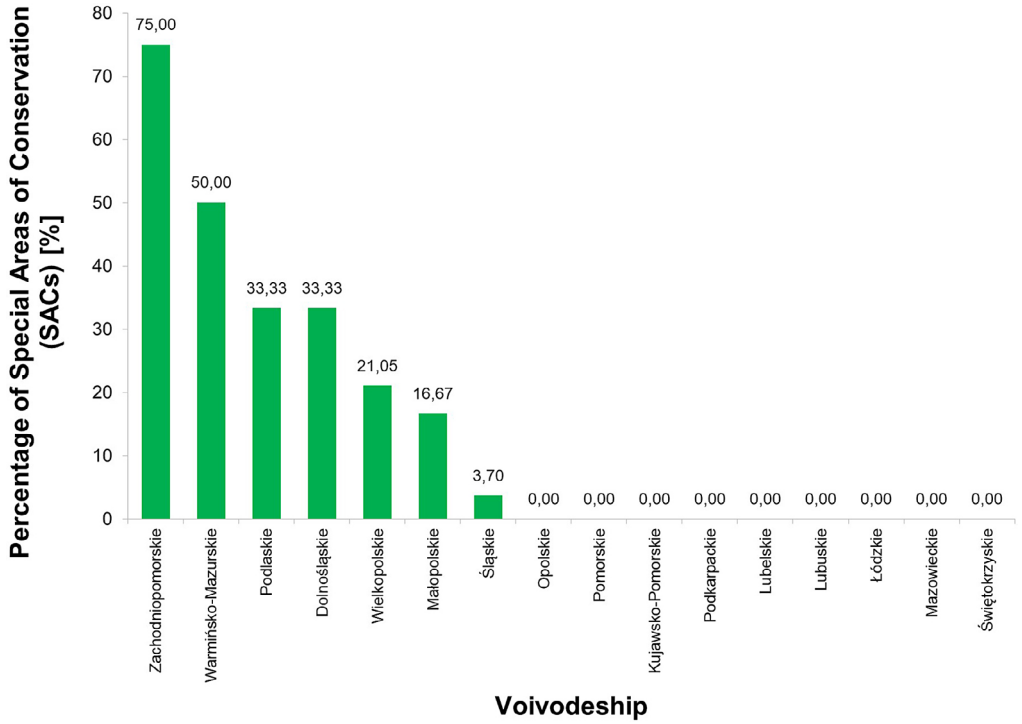

Figure 3. Percentage of special areas of conservation (SACs) established in Poland on or near artificial water reservoirs

River (the "Zbiornik Mietkowski" area). It is important to note that in the Śląskie Voivodeship, which has the largest number of artificial reservoirs in Poland, only one is included in the SPA list – Lake Goczałkowice on the Vistula River (the "Zbiornik Goczałkowicki – Ujście Wisły i Bajerki" area).

In the six remaining voivodeships, no artificial reservoir qualifies for the creation of an SPA area on its territory. Figure 3 shows the percentage of special habitat protection areas established on or near artificial water reservoirs in individual voivodeships. Considering the occurrence of SACs on artificial water reservoirs in individual voivodeships in Poland, it can be concluded that, as in the case of Special Protection Areas for birds, they are predominantly located in northern Poland.

In the Zachodniopomorskie Voivodeship, three reservoirs are on the SACs list. These are Lake Rosnowskie in the municipality of Manowo (the "Dolina Radwi, Chocieli i Chotli" area), Lake Hajka in the Koszalin County (the "Dolina Radwi, Chocieli i Chotli" area) and Niemicki Pond in the Malechowo municipality (the "Dolina Bielawy" area). In the Warmiańsko-Mazurskie Voivodeship, there is one such reservoir – Lake Pierzchalskie in the municipality of Płoskinia (the "Rzeka Pasłęka" area).

There is also one reservoir in the Podlaskie Voivodeship. It is the Zarzeczany Reservoir in the municipality of Gródek (the "Ostoja Knyszyńska" area). In the Wielkopolskie Voivodeship, four artificial reservoirs are on the SACs list. These are Lake Wielkie in the municipality of Chrzypsko Wielkie (the "Puszcza Notecka" area), Lake Bąd in the municipality of Wieleń (the "Dolina Miały" area), Lake Mileczki in the municipality of Wieleń (the "Puszcza Notecka" area) and Lake Małe in the municipality of Pobiedziska (the "Ostoja Międzychodzko-Sierakowska" area).

In the Dolnośląskie Voivodeship, four of the twelve artificial reservoirs are included in the SACs list. These are the Dobromierz Reservoir in the Świdnica County (the "Dobromierz" area), Lake Kaczorowskie in the Bolków Municipality (the "Góry i Pogórze Kaczawskie" area), Lake Bystrzyckie (Lake Lubachowskie) in the municipality of Walim (the "Ostoja Nietoperzy Gór Sowich" area), and Lake Pilchowickie in the municipality of Wleń (the "Ostoja nad Bobrem " area).

There are two reservoirs in the Małopolskie Voivodeship included in the SACs list. These are Lake Klimkowskie on the Ropa River (the "Ostoje Nietoperzy Powiatu Gorlickiego" area) and the Sromowce Reservoir on the Dunajec River (the "Pieniny" area). In the Śląskie Voivodeship, as in the case of SPAs, only one reservoir is included in the list of SACs – Lake Goczałkowice on the Vistula River (the "Zbiornik Goczałkowicki - Ujście Wisły i Bajerki" area). In the nine remaining voivodeships, there are no special areas of habitat protection in artificial water reservoirs.

CONCLUSIONS

The results of the analyses conducted challenge the commonly accepted view that the construction of dams and artificial water reservoirs has an unequivocally negative impact on the natural environment. A significant number of such structures in Poland have been included in the Natura 2000 network for protection, both as SPAs for birds and SACs for habitats. Artificial reservoirs, in particular their backwater zones and other hard-to-reach areas, create favourable conditions for wild species to live, reducing human pressure. These areas thus play an important role in preserving biodiversity.

Hydrotechnical structures, although undoubtedly constituting a significant interference with the natural environment, can at the same time generate positive ecological effects, constituting a specific form of compensation for nature. Unlike many other infrastructure investments, hydrotechnical facilities can create new, valuable habitats and contribute to increasing biodiversity.

The relationship between the dam under construction and the surrounding natural environment is complex and multidimensional, which poses a significant design challenge. A comprehensive analysis of potential impacts is necessary, and the facility must be designed in such a way that the cumulative negative effects are minimised and the environmental benefits are maximised. In the case of hydrotechnical structures, this goal can be achieved as long as the following conditions are met.

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