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INLAND FISHERIES MANAGEMENT IN POLAND – CURRENT STATE AND INSTITUTIONAL CONDITIONS

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ABSTRACT: The state, development directions, opportunities and ways to improve inland fisheries management in Poland are described and discussed. Most of the country's inland waters are public. For fishing purposes, they are divided into fisheries districts. With exceptions, users of the fishing districts are selected through competitions. The user is obliged to conduct rational fisheries management in accordance with a fisheries management plan. Attention is drawn to the overdeveloped national fisheries administration and the possibilities for improvement. The fish stocks in the fishing districts are exploited by both a small group of commercial fishermen and a large group of anglers. While the information covering the basic data on harvest, stocking and other treatments in commercial fisheries can be considered sufficient, the lack of information about the number and catches of anglers is the greatest obstacle to the implementation of rational fisheries management. The preparation of a universal and mandatory system for acquiring angling data should be a priority for the national water administration, representing the owner of public inland waters in Poland.

KEYWORDS: inland fisheries, commercial, angling, rational fisheries management, supervision and control of inland fisheries

Introduction

Inland fisheries are any activity conducted to extract fish and other aquatic organisms from inland waters (FAO, 2023). In this case, the term “inland waters” refers to lakes, rivers, streams, creeks, ponds, inland canals, dams and other usually freshwater inland waters. It does not include fish ponds and other facilities for the rearing and breeding of fish and other aquatic organisms that are used in aquaculture. Although aquaculture supports inland fisheries, mainly in the production of stocking material, inland fisheries primarily include commercial fisheries and recreational fisheries (Welcomme et al., 2010; Czarkowski et al., 2012). Commercial fisheries refers to professional fishing with legal authorisation to sell fish. As a rule, it involves catching naturally occurring fish using a variety of gear and fishing methods (e.g., trawls, gillnets, seines, traps and fence barriers) (FAO, 2019). Recreational fisheries, on the other hand, is any fishing for which the primary motive is leisure rather than profit, the provision of food or the conduct of scientific research and which does not involve the sale, barter, or trade of part or all of the catch (Funge-Smith, 2018). In Poland, recreational fishing is defined as amateur fishing with a rod or speargun. However, it is permitted to catch fish for bait with a bait fish net at the same place and time as fishing with a fishing rod (Act, 1985).

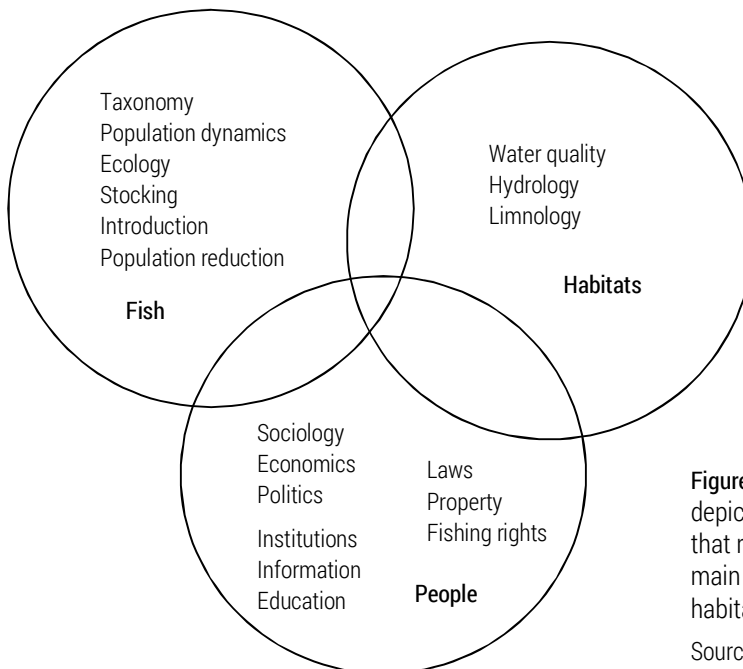


Figure 1. Inland fisheries system is depicted as three overlapping circles that represent the three interacting main components of fisheries – fish, habitats, and people

Source: authors' work based on Nielsen (1993); Siponnen (1999).

The above definitions focus on the purpose and means of exploiting fish resources. More broadly, inland fisheries form a system with three basic elements: fish, their habitats, and people (Figure 1). Social, economic and institutional aspects are now also referred to as the human dimensions of inland fisheries management (Arlinghaus, 2004; Koemle et al., 2021).

The aim of the study is to present the environmental and institutional conditions of inland fisheries management in Poland and its current state, along with an indication of its weaknesses, possibilities and ways to improve it. There are no similar studies in the Polish literature. The available information on the management of inland fisheries in Poland in foreign studies (Aps et al., 2004; Michell et al., 2010; Kaczkowski & Grabowska, 2016) is very general and refers to earlier outdated legal conditions. Better management of Polish inland fish resources should help to minimise tensions between different groups of users of these resources and improve the condition and conservation of living resources in Polish inland waters.

Inland surface waters in Poland

The total area of Poland's inland waters is estimated at 6600 km², which is about 2% of the country's area (GUS, 2022). Poland is almost entirely in the catchment area of the Baltic Sea (99.7% of the country's area): the basins of the largest rivers, such as the Vistula and Oder, belong to it. The remaining 0.3% of the country's territory is occupied by rivers that are part of the catchment systems of the Black Sea (0.2%) and the North Sea (0.1%). Most of Poland's rivers flow in a northwesterly direction, in line with the slope of the country's surface (GUS, 2022).

Lakes in Poland cover nearly 2810 km² that, is approximately 0.9% of the country's area, and they are located mainly (95.9%) in its northern part, forming three geographical regions (lake districts): the Pomeranian Lake District, the Masurian Lake District and the Great Poland-Kuyavian Lake District (Choiński et al., 2011). Most Polish lakes are small. Over 57% of all lakes are smaller than 10 ha, and there are only 28 lakes larger than 1000 ha. (Szczerbowski, 2008). Polish lakes are shallow, and their depth rarely exceeds 50m. The deepest lake, Hańcza, is 108.5m deep. The majority of Polish lakes are eutrophic.

The lakes store about 18.2 billion m³ of water – more than five times the capacity of the country's retention reservoirs. The ability to extract water is one of the many potential services provided by the lakes. Of far greater social and economic value are their other functions, including recreational, ecological, scenic and fishing. Maintaining and developing the multifunctional character of the lakes while maintaining the necessary high quality of their waters

should be the main goal of managing these water resources (Turkowski, 2016).

Dam reservoirs in Poland, as elsewhere, are constructed for specific purposes. Control of floods and regulation of water flow are the main reasons for building dam reservoirs. They may also be used for energy production, irrigation, drinking water reservoirs, navigation as well as for commercial and recreational fisheries. There exists only a small number of Polish dam reservoirs with little holding capacity. The total volume of the 140 biggest reservoirs is about 2.8 billion m³, representing 5% of the total volume of water flowing out of Poland per year (Szczerbowski, 2008; GUS, 2022).

The total area of Polish rivers is estimated at about 1380 km² (Szczerbowski, 2008). The majority of the few large rivers that is longer than 500 km stretches (Vistula, 1022 km; Oder, 726km; Warta, 795 km; Western Bug, 774 km), together with prevailing small- and medium-sized rivers can be classified as potamon environments (reaches at lower elevations characterised by reduced flow, higher temperature and lower dissolved oxygen levels) (Kaczkowski & Grabowska, 2016). Rhithron zones (riffles and pools) with well-developed fish assemblages typical for brown trout (*Salmo trutta fario* L.) and grayling (*Thymallus thymallus* L.) can be found only in the south of the country where mountains and highlands are present (3% of territory over 500m) and in north where rivers cross postglacial areas with well-preserved moraines (Kaczkowski & Grabowska, 2016). Surveys carried out in 2016-2021 on a selected significant number of Polish inland surface waters in relation to WFD requirements showed that only 0.05% of them were in good condition. The rest were in poor condition (GUS, 2022). Water quality, especially in rivers flowing through industrial areas, can change rapidly, so that the current situation may be short-lived. In July/August 2022, there was an environmental accident in Poland's second largest river, the Oder, resulting in nearly 250 tons of dead fish being hauled out of the water (Kolada, 2022) and the authorities issuing a temporary ban on entering the river and using its water for any purpose. There is still no complete information on the causes of the disaster.

In general, Polish surface waters, mainly rivers, are characterised by poor environmental quality, very low renewability, low water storage capacity in reservoirs, but also relatively low water consumption compared to other European countries (Majewski, 2018).

Commercial fisheries

It is estimated that the inland fishing sector in Poland employs a total of around 1,000-2,000 people, some on a full-time and some on a part-time basis (Funge-Smith, 2018; Wołos et al., 2022). Accurately estimating the number of professional inland fishermen is difficult, as most inland fish farms are also engaged in aquaculture, as well as, on a smaller scale, tourism, catering and other activities. Commercial harvesting is conducted primarily in lakes (270,000 hectares) and dam reservoirs (about 50,000 hectares) (Wołos & Draszkiewicz-Mioduszezewska, 2022; Trella et al., 2022). The area where commercial fishing is practised is generally limited to the lake districts of northeastern Poland and a few dam reservoirs, accounting for less than 40% of inland waters. These waters are also mostly made available to anglers for a fee. Revenue from this accounted for around 20% of total inland fish farm revenue (Wołos et al., 2022).

Commercial landings from 238 990 ha (88% of the registered total commercial fishing area of Polish lakes) in 2021 constituted 1378 t of fish (Wołos & Draszkiewicz-Mioduszezewska, 2022). 55% of the total catch was cyprinids: bream (*Abramis brama* L.) (30%), roach (*Rutilus rutilus* L.) (9%), prussian carp (*Carassius auratus gibelio* B.) (7%) and tench (*Tinca tinca* L.) (6%). 28% of total catch was carnivorous: Northern pike (*Exos lucius* L.) (10%), perch (*Perca fluviatilis* L.) (8%), pikeperch (*Sander lucioperca* L.) (6%) and European eel (*Anguilla anguilla* L.) (4%). Vendace (*Coregonus albula* L.), the only commercial species not caught by anglers, also accounted for a significant share of commercial landings (16%).

Stocking is one of the most important treatments used in Polish fisheries management. Stocking of fishing districts mainly included eel, vendace, northern pike, whitefish (*Coregonus lavaretus* L.), pikeperch and European catfish (*Silurus glanis* L.). In 2021, the value of fish stocking was 67% in relation to the total value of commercial catches, while 33% in relation to the total revenue of the sector, including income from angling permits sold by commercial fish farms (Mickiewicz, 2022).

Recreational fisheries

Angling takes place on almost all waters, whether they are managed by commercial fishermen or angling associations. It is estimated that angling may be carried out nationwide by 1.0-1.5 million people (Funge-Smith, 2018; Trella & Wołos, 2022). This means that between 2.6% and 4% of Poles participate in recreational fishing. This is not much compared to the Scandina-

vian countries, where this share varies between 14 and 42% (Arlinghaus et al., 2021). However, recreational fishing is considered to be one of the dominant forms of outdoor recreation in Poland. The available data indicate that this phenomenon is declining. The Polish Angling Association (PAA), which remains the largest user group of inland waters in Poland, boasted a count of over 1 million memberships in the early 1980s; yet that number has since diminished to roughly 0.63 million in 2020 (Państwowe Gospodarstwo Wodne Wody Polskie, 2023). The commercial Polish fisheries enterprises have also noted a decline in selling of the more expensive long-term permits for angling in favor of affordable short-term licenses (Arlinghaus et al., 2021).

The PAA uses 66% of rivers, 88% of reservoirs and 21% of lakes for fisheries purposes (Vehanen et al., 2020). It is estimated that anglers catch between 10,000 and 15,000 tonnes of fish each year (Kupren et al., 2018). This is almost 10 times more than the domestic commercial fishermen. In contrast to many Western countries, catch and release in Poland is rare and most of the catch is consumed. Even coarse fishes, like roach or bream, rarely caught by anglers in European countries (Winfield, 2016; Dainys et al., 2022), are highly desirable (Kaczkowski & Grabowska, 2016; Czarkowski et al., 2021). Recreational fishing is more selective than commercial fishing. Many anglers prefer predatory species such as pike, perch, zander and eel. Ultimately, however, the structure of angling catches reflects the state of ichthyofauna appropriate to the ecology of a given water body (Kaczkowski & Grabowska, 2016; Trella & Wołos, 2022). Recently, there has also been a trend towards social acceptance of voluntary catch and release, especially among younger Polish anglers, with over 70% of the angling population stating that they often or always release the fish they catch (Arlinghaus et al., 2021).

It is worth noting that recreational fisheries represent a special case within the set of fisheries in that practitioners do not rely on the activity for their livelihood and that many of the terms in calculating their value lie outside the fishery itself (Aps et al., 2004). Recreational fishers are usually prepared to spend considerable sums of money on their sport, not only in licenses for access to the fishery but for gear, transport and accommodation. Resource owners, professional assistants, boatowners, etc., may depend on the recreational fishery for their livelihood, and the recreational fishery may thus contribute significantly to local economies through its employment potential (Curtis et al., 2017; Lynch et al., 2016; American Sportfishing Association, 2021). In this way, the product of the fishery in terms of fish is only of small significance, and other aspects of the fishery, such as aesthetic enjoyment and local economics, become more important. The direct global cost of recreational fishing is estimated at over \$44 billion, while its indirect costs are estimated at over \$100 billion a year (FAO, 2023).

Water property and fishing rights

Inland fisheries in Poland are regulated by two basic legal acts: the Inland Fisheries Act (1985) and the Water Law (2017), with relevant implementing regulations. Rivers, dam reservoirs and most lakes in Poland are classified as public inland flowing waters and, according to the Water Law (2017), are the property of the State Treasury and are not subject to civil trade. In contrast, only smaller lakes classified as standing waters belong to property owners and can be traded under civil law (Turkowski, 2017; Hakuć-Błażowska et al., 2020). For fishing usage, Polish public inland waters are divided into basic and supplementary fisheries districts. The basic fisheries district includes the waters of lakes, reservoirs, rivers, canals and natural watercourses necessary for rational fisheries management. The supplementary fisheries district (which is assigned to particular basic fisheries districts) includes the flowing waters of the tributaries of the basic fishing district, on which the fisheries activity can be carried out periodically. Districts, both in terms of size and limnological and biological parameters, can be very diverse. The official census in 2022 included 2,222 basic fishing districts in Poland (Państwowe Gospodarstwo Wodne Wody Polskie, 2023). Fish and other organisms living in the water are the benefits, the collection of which is intended only for the owner of the public waters. However, these fishing rights may be transferred to another user following the appropriate legal procedures. The authority for fisheries in fisheries districts is the director of one of the 11 Regional Water Boards (RWAB), which represents the owner of public waters – the State Treasury. If desired, the director also has the right to carry out his own fisheries activity in a given district. To date, the few attempts at such activities have resulted in significant financial losses (NIK, 2020). Usually, the appropriate fishing user is selected through a formal competition process (Figure 2).

There are no special formal restrictions on who can enter a competition. The official regulation (2020) treats both private and legal persons, fisheries enterprises, angling associations and other large and small organisations equally. All of them can participate in a competition. A substantive assessment of the potential and feasibility of rational fisheries management in a given fishing district by the offeror is important. The competition committee first checks the compatibility of the bid elements with the district's fishery management plan and the type of fishery management specified therein. And then, after positive verification, goes the scoring of the required elements of the offer: the qualifications and professional experience of the offeror or the person conducting the fishery on its behalf, the amount of the annual fee, the amount of the proposed material and financial expenditures, and the species composition of the planned stocking. The offeror with the highest number of

points concludes a contract for the use of the fishing district with the authorised director of RWAB. The contract is concluded for a period of not less than 10 years for an annual fee. The period may be longer, but it must always be stated in the contract. The law does not specify a maximum period of use. However, no fee is charged for the part of the fisheries district constituting protection zones, supplementary fisheries districts and waters unsuitable for rational fisheries management. The main reasons for recognising waters as unsuitable for rational fisheries management are their pollution, which significantly worsens the living conditions of fish or mass outbreaks of fish diseases.

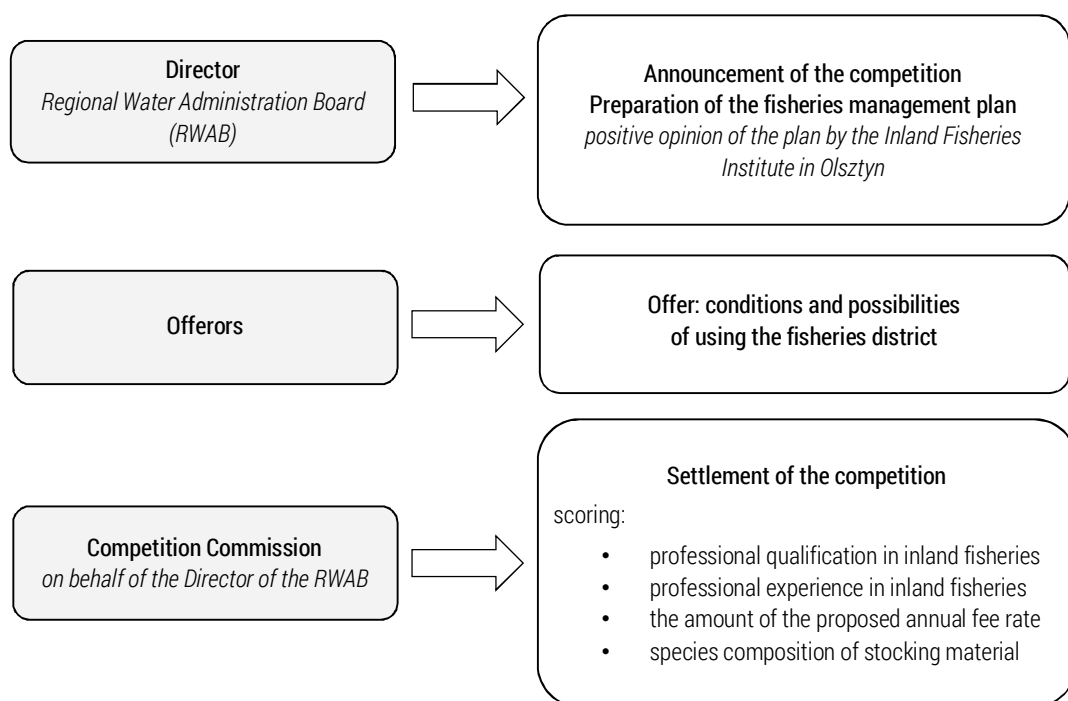


Figure 2. Basic stages of the offers competition for fisheries usage of fisheries districts

Source: authors' work based on Regulation (2020).

Rational fisheries management

Rational fisheries management is a basic principle of Polish fisheries law. Its concept has been amended several times (Danecka & Radecki, 2022). In its original version from 1985, it was based on maximising the productive capacity of water in accordance with existing natural conditions and the state

of knowledge at the time. At present, in accordance with the principle of sustainable development, the goal of rational fisheries management is to maintain fish stocks in biological balance and at a level that allows future fishermen to benefit from them. A key role in this task is played by the fisheries management plan, which specifies in detail the management goals and methods in a given fisheries district.

Approval of the plan requires the opinion of the Inland Fisheries Institute and is based on a positive assessment of each of three criteria: the substantive correctness of the plan, the advisability of the assumptions of the plan in terms of using the productive capacity of the waters while preserving fish stocks in biological balance and at a level that will allow their economic use in the future, and the compatibility of the assumptions of the plan with the requirements of protection of the Natura 2000 area and other forms of nature protection. This includes the requirements of national regulations, which must comply with EU directives. It is the responsibility of the user of each fisheries district to manage the fishery according to the fisheries management plan and the concluded contract for the use of the fisheries district. Failure to do so will result in the user being called in by the Marshal's Office to correct the fishing management, and, in the event of non-compliance, the user's fishing rights will be withdrawn.

Deviation from this rule is allowed only under special conditions, such as a sudden deterioration in water quality or quantity. Draft plans prepared by offerors often overestimated the size of the proposed stockings, which contributed significantly to winning the competition. Currently, the plan is prepared by the director of the RWAB, which should ensure an optimal level of stockings, appropriate to the needs of the fisheries district, in line with the principle that the stocking must not cause a reduction or loss of biodiversity of its living resources. A wide range of stocked fish is allowed, from fry to adult fish. Preferably from the same lake or catchment area, but if there is a problem, e.g., no suitable local producer, fish for stocking can come from other parts of the country.

Inland fisheries management in Poland is supervised and controlled by a number of public institutions (Table 1).

The Ministry of Agriculture and Rural Development is responsible for fisheries management in Poland. The Inland Fisheries Institute is the main research institute for carrying out research in the field of inland fisheries and inland fisheries economics. Fisheries management inspections in fisheries districts mainly consist of checking the documentation required by the regulations and kept by fishery users: management books for lakes and other water reservoirs, catch and stocking reports, and annual reports. Reported treatments are also checked, mainly stocking campaigns.

Table 1. Public institutions involved in the management of Polish inland fisheries

Institution	The scope of competence
Ministry of Agriculture and Rural Development (minister responsible for inland fisheries)	supervises the implementation of the tasks of inland fisheries by the State Water Enterprise – Polish Waters determines the detailed conditions for protecting and catching fish, fishing gear and fishing equipment, rules for the establishment of fisheries districts, breeding and protection zones and the marking of these zones
Voivode – Governor (state administration)	establishment and abolition of fisheries districts (from 2018) supervision of the State Fishery Guard
Director RWAB (State Water Enterprise – Polish Waters; national water administration)	preparation of the fisheries districts management plans (from 2020) right to fisheries use of fisheries districts handover of fisheries districts for use control and evaluation of fish stocking and harvesting in the fisheries districts
Inland Fisheries Institute (research institute of the Ministry of Agriculture and Rural Development)	providing an opinion on fisheries management plans (as a solely authorized entity from 2020) conducting public statistics of national inland fisheries
Voivodeship board – Provincial board (provincial government)	establishment or abolition of protective zones indicating the place and time when a total or partial ban on amateur fishing (angling) is in force
Marshall of voivodeship – province (provincial government)	control and evaluation of rational fisheries management in fisheries districts
State Fishery Guard (state administration)	control of compliance with the Inland Fisheries Act and regulations issued on its basis (also in cooperation with the police and Social Fishery Guard)
Starosta – county governor (county government)	issue of angling and underwater hunting cards issue of permits for partitioning with net fishing gears more than half the width of flowing waters not classified as inland navigable waters issue of permits for setting net fishing gear in navigable inland waters in the navigable route or in its immediate vicinity applying to the County Council, for the establishment of a Social Fishery Guard or consent to its establishment by interested social organizations or fishing rights holders (users of fisheries districts)

Source: authors' work based on Act (2017); Act (1985).

Discussion

Formally, the Ministry of Agriculture and Rural Development is responsible for fisheries management in Poland. On the other hand, the institution with the most extensive powers in the field of fisheries management of inland public waters – State Water Enterprise – Polish Waters – is subordinated to the Ministry of Infrastructure. In practice, this means that two ministries are responsible for inland fisheries in Poland. In most European countries, the Ministry of Environment is responsible for inland fisheries, less often the agriculture ministry. However, in none of these countries are there two paral-

lel ministries in charge of inland fisheries (Vehanen et al., 2020). At least five public administration entities at the regional level supervise and conduct inspections of fisheries management in Poland (Table 1). The need to reform and reduce the size of the fisheries administration may be indicated by the lack of a sufficient number of staff trained in inland fisheries. Despite a large number of inspections, the work of the administration is complicated by a significant shortage of qualified employees in the field of inland fisheries in most public institutions (NIK, 2020). The right way to improve fisheries management would be to simplify the management structure by reducing the number of institutions involved. These could be relatively straightforward were it not for the fact that one of the central institutions in fisheries management – Polish Waters – may itself be a fisheries user in a fisheries district. In this case, it must itself be subject to appropriate supervision and control. This requires maintaining a kind of “loop” of mutual supervision of relatively independent institutions. Restricting the possibility of using fisheries districts to exceptional situations, e.g. when there are no other users willing to manage the district, and extending the supervisory powers of the Polish Waters could be the right direction of change that would contribute to improving the efficiency of inland fisheries management in Poland.

As mentioned above, fisheries districts are used simultaneously and to varying degrees by a small group of professional fishermen (approx. 1000-2000) and a large group of anglers (approx. 1.0-1.5 million). The capacity of freshwater commercial fisheries and the huge number of recreational fishermen create a situation where the pressure on fish stocks and associated biodiversity is excessive. The situation is generally exacerbated by a lack of effective information on fish exploitation. While the information covering basic data on commercial catches, stockings and other treatments should be considered sufficient, the lack of information on the pressure and catches of anglers is currently the biggest obstacle to the implementation of rational fisheries management in Poland. So far, no universally valid mechanisms have been put in place for reliably obtaining this type of information (NIK, 2020). At present, the catch registers maintained by the Polish Angling Association (PAA) (anglers report their catches) are the main source of information on the size of Polish angling catches. The PAA has also tested a portal for online registration of angler catches. Generally, the data obtained from the records are incomplete due to the different levels of records in particular districts, the lack of information on catches of visiting anglers and the problem of reliability of data entered into registers (Vehanen et al., 2020). In practice, this makes it difficult to enforce the catch limits set out in fisheries management plans and fisheries agreements. Poor quality fisheries statistics could easily jeopardise statistically based scientific assessments of fish stocks and science-based management advice. The extent of misreporting of catches is

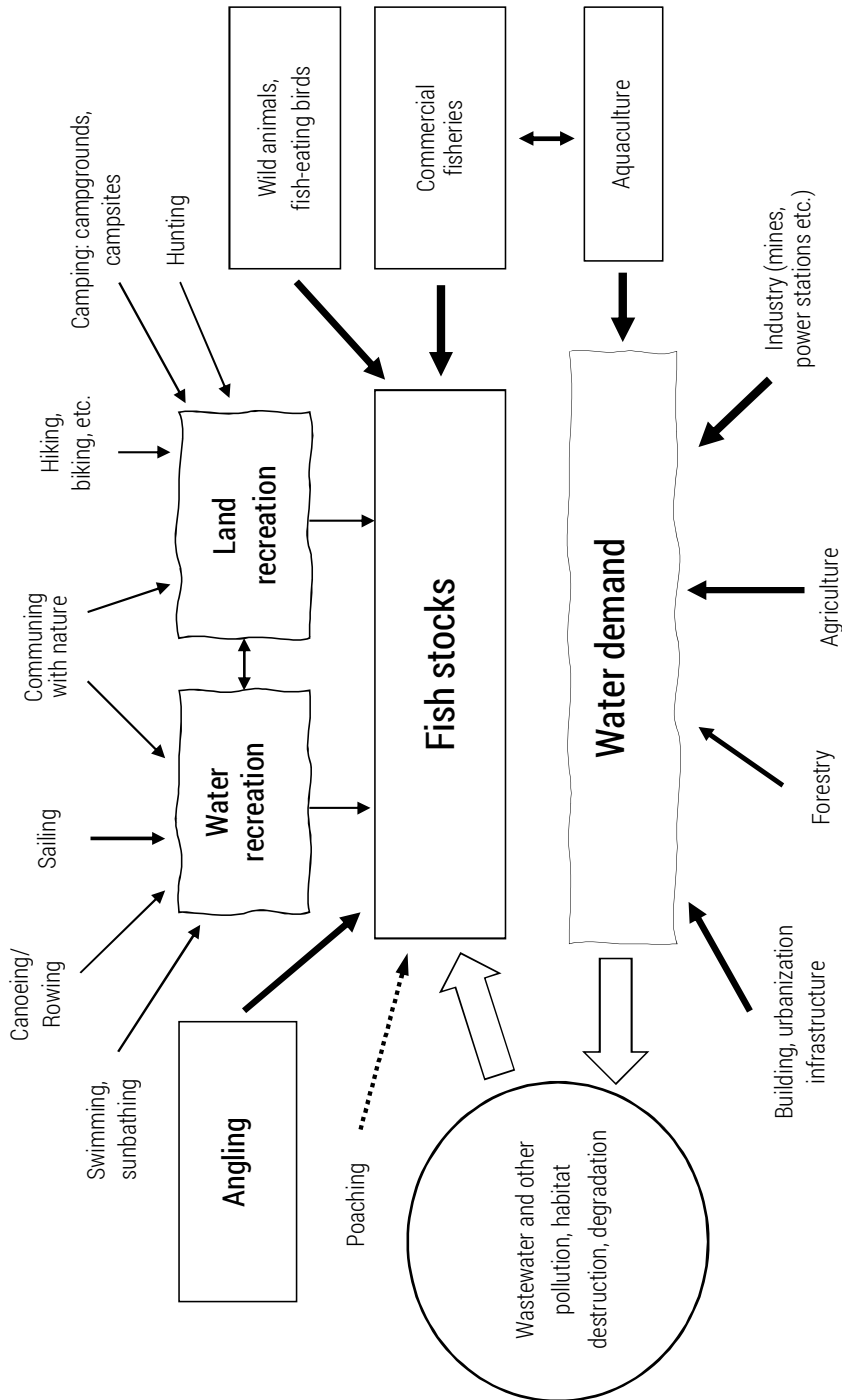


Figure 3. Inland fish stocks resources and their determinants

Source: authors' work based on Arlinghaus et al. (2002).

also not usually known (Aps et al., 2004). Many of the available data collection methods, depending on recreational fisheries with a strong focus on angling, are presented in an FAO study (Vehanen et al., 2020). Whatever methods are used, it is important that anglers are aware of and involved in the data collection process and that data collection requirements are properly monitored and enforced. Education and training of anglers in this area continue to play a vital role.

Inland fisheries and fishery resources are strongly influenced by other users of water bodies and their catchments (Figure 3).

Management of inland fisheries, therefore, requires an ecosystem approach, taking into account biological, human, economic and social factors within and beyond the waters of the fisheries district. The involvement of relevant stakeholders and the planning, development and management of inland fisheries in a way that can strive to meet the diverse needs and desires of societies is a constant feature of this approach. The approach also places a priority on sustainability to ensure that short-term actions do not jeopardise the options for future generations to benefit from the full range of goods and services provided by inland water ecosystems (FAO, 2023). Such integrated resource management for sustainable freshwater fisheries can be effectively achieved by involving critical stakeholders in appropriate discussions and decision-making. It is fundamental to ensure closer involvement of stakeholders in discussions and decision-making (Aps et al., 2004; Arlinghaus et al., 2016). An example of the search for such a dialogue could be the stocking of lakes by commercial fishing farms, with the participation of anglers. Recreational fisheries management requires a rapid transition from single-objective management to ecosystem management and aquatic stewardship (Arlinghaus et al., 2016). The joint cleaning of the lakes by anglers and local people, initiated by the fishermen, is one of many small examples of activities in this direction. There is a well-known example of a user of a fisheries district who prepared a lake protection programme and managed to coordinate local and regional institutions around it, including two municipal offices, the Regional Directorate for Environmental Protection and the Department of Water Protection Engineering at the University of Warmia and Mazury in Olsztyn (Turkowski, 2020). Inland fisheries management should take into account the uncertainty and complexity of fisheries in the context of the wider socio-ecological system. This is where adaptive management can help, as it theoretically addresses the constraints of managing fisheries and allows uncertainty to be incorporated into the decision-making process. However, applying adaptive management to fisheries is not straightforward, and the available literature highlights difficulties in implementation, including barriers and challenges (Walters, 2007; Edmondson & Fanning, 2022).

Fisheries do not have the administrative and planning tools to influence the management of water resources and catchment areas. On the other hand, the State Water Enterprise – Polish Waters (SWE-PW) has the relevant tools to ensure that any activity related to water resources and their catchment areas is subject to an assessment of its impact on fisheries resources as an integral part of water resources. SWE-PW should be responsible for assessing the impact on fish resources of various forms of river basin management provided for in draft planning documents. SWE-PW should eliminate and reduce activities that may adversely affect the quality and abundance of fish stocks, and where this is not possible, appropriate compensation should be paid to users of the fisheries district or into a fisheries fund that could be used in the future to restore fish stocks.

Conclusions

The capacity of freshwater commercial fisheries and the huge number of recreational fishermen create a situation where the pressure on fish stocks and associated biodiversity is excessive. The situation is generally exacerbated by a lack of effective information on fish exploitation. While the information covering basic data on commercial fisheries should be considered sufficient, the lack of information on the pressure and catches of anglers, also from inland commercial fish farms, is currently the biggest obstacle to the implementation of rational fisheries management in Poland. A universal and mandatory system for obtaining the above information could be established on the basis of proven domestic and foreign solutions (Vehanen et al., 2020). Action in this direction should now be a priority for the State Water Enterprise – Polish Waters, representing the owner of Poland's public inland waters.

Future perspectives

Anglers awareness plays a crucial role in the process of collecting the data necessary for truly knowledge-based management of inland fisheries in Poland. They should be convinced of the importance of participation in the collection of complete and reliable data for that purpose. And be fully committed to this task.

Management of inland fisheries in Poland is complicated. There is a need for a simplification of the management structure through a reduction in the number of institutions involved. The key element of the above changes could be to limit the use of fisheries districts while increasing the supervisory powers of Polish Waters.

Management of inland fisheries requires an ecosystem approach, taking into account biological, human, economic and social factors within and beyond the waters of the fisheries district. The involvement of relevant stakeholders and the planning, development and management of inland fisheries in a way that can strive to meet the diverse needs and desires of societies is a constant feature of this approach. The State Water Enterprise – Polish Waters has the relevant tools and should be responsible for ensuring that any activity related to water resources and their catchment areas is subject to an assessment of its impact on fish and fisheries as an integral part of water management.

The contribution of the authors

Concept, K.T.; literature review, K.T. and K.K.; acquisition of data, K.T., K.K. and W.K.; analysis, interpretation of data, and modeling, K.T., K.K. and W.K.

References

- Act from 18 April 1985. Inland Fisheries Act. Journal of Laws of 1985 No. 21, item 91. <https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=wdu19850210091> (in Polish).
- Act from 20 July 2017. Water Law. Journal of Laws of 2023, item 1478. <https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20170001566> (in Polish).
- American Sportfishing Association. (2021). *Sportfishing-in-America-Economic-Report-March-2021*. <https://asafishing.org/wp-content/uploads/2021/11/Sportfishing-in-America-Economic-Report-March-2021.pdf>.
- Aps, R., Sharp, R., & Kutonova, T. (2004). *Freshwater Fisheries in Central & Eastern Europe: the Challenge of Sustainability*. https://www.eaa-europe.org/files/iucn_7938.pdf
- Arlinghaus, R. (2004). *A human dimensions approach towards sustainable recreational fisheries management*. London: Turnshare Ltd.
- Arlinghaus, R., Aas, Ø., Alós, J., Arismendi, I., Bower, S., Carle, S., Czarkowski, T., Freire, K. M. F., Hu, J., Hunt, L. M., Lyach, R., Kapusta, A., Salmi, P., Schwab, A., Tsuboi, J., Trella, M., McPhee, D., Potts, W., Wołos, A., & Yang, Z.-J. (2021). Global Participation in and Public Attitudes Toward Recreational Fishing: International Perspectives and Developments. *Reviews in Fisheries Science & Aquaculture*, 29(1), 58-95. <https://doi.org/10.1080/23308249.2020.1782340>
- Arlinghaus, R., Mehner, T., & Cowx, I. G. (2002). Reconciling traditional inland fisheries management and sustainability in industrialized countries, with emphasis on Europe. *Fish and Fisheries*, 3, 261-316. <https://doi.org/10.1046/j.1467-2979.2002.00102.x>
- Arlinghaus, R., Van Anrooy, R., Cooke, S. J., Sutton, S. G., Danylchuk, A. J., Potts, W., Freire, K., Alos, J., Da Silva, E. T., & Cowx, I. G. (2016). Recommendations for the future of recreational fisheries to prepare the social-ecological system to cope with change. *Fisheries Management and Ecology*, 23(3-4), 177-186. <https://doi.org/10.1111/fme.12191>

- Choiński, A., Ławniczak, A., Ptak, M., & Sobkowiak, L. (2011). Causes of Lake Area Changes in Poland. *Journal of Resources and Ecology*, 2(2), 175-180. <https://doi.org/10.3969/j.issn.1674-764x.2011.02.011>
- Curtis, J., Breen, B., O'Reilly, P., & O'Donoghue, C. (2017). The economic contribution of a recreational fishery in a remote rural economy. *Water Resources and Rural Development*, 10, 14-21. <https://doi.org/10.1016/j.wrr.2017.11.001>
- Czarkowski, T. K., Wołos, A., & Kapusta, A. (2021). Socio-economic portrait of Polish anglers: implications for recreational fisheries management in freshwater bodies. *Aquatic Living Resources*, 34, 19. <https://doi.org/10.1051/alr/2021018>
- Czarkowski, T., Kupren, K., Turkowski, K., Kucharczyk, D., Kozłowski, K., & Mamcarz, A. (2012). Recreational fisheries and fishing grounds in the context of the tourist attractiveness of lakeland regions. *Polish Journal of Natural Sciences*, 4, 453-464.
- Dainys, J., Jakubavičiūtė, E., Gorfine, H., Kirka, M., Raklevičiūtė, A., Morkvėnas, A., Pūtys, Ž., Ložys, L., & Audzijonyte, A. (2022). Impacts of recreational angling on fish population recovery after a commercial fishing ban. *BioRxiv*, 483248. <https://doi.org/10.1101/2022.03.07.483248>
- Danecka, D., & Radecki, W. (2022). *Kompendium prawa rybackiego*. Poznań: Wydawnictwo PTR. (in Polish).
- Edmondson, E., & Fanning, L. (2022). Implementing adaptive management within a fisheries management context: a systematic literature review revealing gaps, challenges, and ways forward. *Sustainability*, 14(12), 7249. <https://doi.org/10.3390/su14127249>
- FAO. (2019). *Ecosystem approach to fisheries management training course (Inland fisheries)*. <https://www.fao.org/documents/card/en/c/ca5539en>
- FAO. (2023, April 30). *Inland Fisheries*. <https://www.fao.org/inland-fisheries/background/-management/en/>.
- Funge-Smith, S. J. (2018). *Review of the state of world fishery resources: inland fisheries*. Rome: FAO. <https://www.fao.org/fishery/en/publication/9156>
- GUS. (2022). *Ochrona środowiska 2022*. <https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/srodowisko/ochrona-srodowiska-2022,1,23.html> (in Polish).
- Hakuć-Błażowska, A., Napiórkowska-Baryła, A., & Turkowski, K. (2020). *Wybrane aspekty zarządzania wodą i powierzchnią ziemi ze szczególnym uwzględnieniem planowania przestrzennego*. Olsztyn: Instytut Badań Gospodarczych. <https://doi.org/10.24136/eep.mon.2020.12> (in Polish).
- Kaczkowski, Z., & Grabowska, J. (2016). Problems and challenges of fish stock management in fresh waters of Poland. In J.F. Craig (Ed.), *Freshwater Fisheries Ecology* (pp. 208-215). John Wiley & Sons, Ltd.
- Koemle, D., Beardmore, B., Dorow, M., & Arlinghaus, R. (2021). The human dimensions of recreational anglers targeting freshwater species in coastal ecosystems, with implications for management. *North American Journal of Fisheries Management*, 41, 1572-1590.
- Kolada, A. (2022). *Wstępny raport zespołu ds. sytuacji na rzece Odrze*. <https://ios.edu.pl/wp-content/uploads/2022/10/Wstepny-raport-zespołu-ds.-sytuacji-na-rzece-Odrze.pdf>. (in Polish).
- Kupren, K., Czarkowski, T. K., Hakuć-Błażowska, A., Świszcz, B., Rogulski, M., & Krygel, P. (2018). Socio-economic characteristics of anglers in selected counties of the Warmińsko-Mazurskie Voivodeship. *Studia Obszarów Wiejskich*, 50, 213-226.
- Lynch, A. J., Cooke, S. J., Deines, A. M., Bower, S. D., Bunnell, D. B., Cowx, I. G., Nguyen, V. M., Nohner, J., Phouthavong, K., Riley, B., Rogers, M. W., Taylor, W. W., Woelmer, W.,

- Youn, S.-J., & Beard, T. D. (2016). The social, economic, and environmental importance of inland fish and fisheries. *Environmental Reviews*, 24, 115-121. <https://doi.org/10.1126/sciadv.abn1396>
- Majewski, W. (2018). Zarządzanie zasobami wodnymi w Polsce. Zarządzanie zasobami wodnymi w Polsce 2018, 27-32. <https://ungc.org.pl/wp-content/uploads/2021/04/raport-zarządzanie-zasobami-wodnymi-www-1.pdf> (in Polish).
- Mickiewicz, M. (2022). Zarybianie jezior w 2021 roku i ich porównanie z rokiem 2020. In A. Cejko & A. Wołos (Eds.), *Działalność podmiotów rybackich i wędkarskich w 2021 roku. Uwarunkowania gospodarcze, ekonomiczne, środowiskowe i klimatyczne* (pp. 63-74). Olsztyn: IRŚ. (in Polish).
- Mitchell, M., Vanberg, J., & Sipponen, M. (2010). *Commercial Inland Fishing in Member Countries of the European Inland Fisheries Advisory Commission (EIFAC): Operational Environments, Property Rights Regimes and Socio-economic Indicators*. <https://www.fao.org/3/an222e/an222e.pdf>
- Nielsen, L. A. (1993). History of inland fisheries management in North America. In C.C. Kohler & W.A. Hubert (Eds.), *Inland Fisheries Management in North America* (pp. 3-31). USA: American Fisheries Society.
- NIK. (2020). *Dzierżawa i użytkowanie jezior i obwodów rybackich Skarbu Państwa*. www.nik.gov.pl/kontrola/wyniki-kontroli-nik/kontrola,20543.html (in Polish).
- Państwowe Gospodarstwo Wodne Wody Polskie. (2023). *Ujednolicony wykaz obwodów rybackich*. <https://data.europa.eu/data/datasets/https-dane-gov-pl-pl-dataset-2914-ujednolicony-wykaz-obwodow-rybackich?locale=en> (in Polish).
- PZW. (2020). *Ilość członków PZW info od ZG PZW*. https://www.pzw.org.pl/home/wiadomosci/209642/60/ilosc_czlonkow_pzw_info_od_zg_pzw (in Polish).
- Regulation of the Minister of Maritime Economy and Inland Navigation from 25 August 2020. On the offers competition for putting a fishing district into usage. *Journal of Laws of 2020*, item 1595. <https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20200001595> (in Polish).
- Sipponen, M. (1999). *The Finnish inland fisheries system. The outcomes of private ownership of fishing rights and of changes in administrative practices*. Jyväskylä: Biological Research Reports from the University of Jyväskylä.
- Szczerbowski, J. (2008). *Rybacko-środłądowe*. Olsztyn: IRŚ. (in Polish).
- Trella, M., & Wołos, A. (2022). Presja i połowy wędkarskie w jeziorach użytkowanych przez gospodarstwa rybackie w 2021 roku. In A. Cejko & A. Wołos (Eds.), *Działalność podmiotów rybackich i wędkarskich w 2021 roku. Uwarunkowania gospodarcze, ekonomiczne, środowiskowe i klimatyczne* (pp. 115-126). Olsztyn: IRŚ. (in Polish).
- Trella, M., Wołos, A., & Czerwiński, T. (2022). Zmiany klimatyczne i ich wpływ na gospodarkę rybacką i wędkarską prowadzoną w zbiornikach zaporowych. In A. Cejko & A. Wołos (Eds.), *Działalność podmiotów rybackich i wędkarskich w 2021 roku. Uwarunkowania gospodarcze, ekonomiczne, środowiskowe i klimatyczne* (pp. 127-144). Olsztyn: IRŚ. (in Polish).
- Turkowski, K. (2016). Własność i zarządzanie jeziorami a problem ich zrównoważonego użytkowania. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, 453, 153-166. (in Polish).
- Turkowski, K. (2017). Governance of publicly owned lakes in Poland – the current state and underlying conditions. *Economics and Environment*, 60(1), 92-102. <https://ekonomiaisrodowisko.pl/journal/article/view/240>

- Turkowski, K. (2020). Water Resources Management in Poland: The Case of Lakes Governance. *Proceedings of the 35th International Business Information Management Association Conference (IBIMA)*, Spain, 2803-2811. https://www.researchgate.net/profile/Konrad_Turkowski/publication/344266833_Water_resources_management_in_Poland_the_case_of_lakes_governance/links/5f61ed1b4585154dbbd57dc5/Water-resources-management-in-Poland-the-case-of-lakes-governance.pdf
- Vehanen, T., Piria, M., Kubečka, J., Skov, C., Kelly, F., Pokki, H., Eskelinen, P., Rahikainen, M., Keskinen, T., Artell, J., Romakkaniemi, A., Suić, J., Adámek, Z., Heimlich, R., Chalupa, P., Ženíšková, H., Lyach, R., Berg, S., Birnie-Gauvin, K., Jepsen, N., Koed, A., Pedersen, M. I., Rasmussen, G., Gargan, P., Roche, W., & Arlinghaus, R. (2020). *Data collection systems and methodologies for the inland fisheries of Europe*. <https://www.ifishman.de/publikationen/einzelansicht/1532-data-collection-systems-and-methodologies-for-the-inland-fisheries-of-europe/>
- Walters, C. J. (2007). Is Adaptive Management Helping to Solve Fisheries Problems? *AMBIO: A Journal of the Human Environment*, 36(4), 304-307. [https://doi.org/10.1579/0044-7447\(2007\)36\[304:IAMHTS\]2.0.CO;2](https://doi.org/10.1579/0044-7447(2007)36[304:IAMHTS]2.0.CO;2)
- Welcomme, R. L., Cowx, I. G., Coates, D., Béné, Ch., Funge-Smith, S., Halls, A., & Lorenzen, K. (2010). Inland capture fisheries. *Philosophical Transactions of The Royal Society B Biological Sciences*, 365(1554), 2881-2896. <https://doi.org/10.1098/rstb.2010.0168>
- Winfield, I. J. (2016). Recreational fisheries in the UK: natural capital, ecosystem services, threats, and management. *Fisheries Science*, 82, 203-212. <https://doi.org/10.1007/s12562-016-0967-y>
- Wołos, A., & Draszkiwicz-Mioduszevska, H. (2022). Wielkość i charakterystyka jeziorowej produkcji rybackiej w 2021 roku. In A. Cejko & A. Wołos (Eds.), *Działalność podmiotów rybackich i wędkarskich w 2021 roku. Uwarunkowania gospodarcze, ekonomiczne, środowiskowe i klimatyczne* (pp. 13-24). Olsztyn: IRŚ. (in Polish).
- Wołos, A., Czerwiński, T., & Mickiewicz, M. (2022). Sytuacja ekonomiczno-finansowa podmiotów uprawnionych do rybackiego użytkowania jezior w 2021 roku. In A. Cejko & A. Wołos (Eds.), *Działalność podmiotów rybackich i wędkarskich w 2021 roku. Uwarunkowania gospodarcze, ekonomiczne, środowiskowe i klimatyczne* (pp. 25-38). Olsztyn: IRŚ. (in Polish).