02.08 Fish Fauna 2022

Introduction

Water Bodies and Fish Communities

Berlin's waterscape was shaped during the second stage of the Weichselian Glaciation, known as the Brandenburg Stage, which ended about 10,300 years ago. The Berlin Glacial Spillway is part of the Glogau-Baruth Glacial Spillway, which extends along the Weichselian end moraines of the Brandenburg Stage. Nestled within the North German Plain, Berlin's waterscape is characterised by its prominent rivers, the Spree and the Havel. Together with their lake-like expansions, these rivers account for nearly two-thirds of Berlin's water surface, totalling 5,952 hectares, or about 6.67 % of the city's area. The Dahme and Spree rivers flow from the southeast into the Berlin Glacial Spillway, weaving through the city from east to west over 16.4 kilometres and 45.1 kilometres, respectively. Meanwhile, the Havel river enters from the north and meanders southward for 27.1 kilometres. The city's largest water body is the lake-like expansion of the Unterhavel, spanning 1,175 hectares.

In addition to the rivers and canals that shape Berlin's unique cityscape, there are 58 lakes larger than one hectare that lie at least partially within the city limits. Among these, the most remarkable are the fluvial lakes, featuring both river inflows and outflows. The Großer Müggelsee reigns as the largest lake, stretching across 766 hectares. In contrast, the Groß-Glienicker See stands as the sole substantial groundwater-fed lake. It is situated along Berlin's southwestern border with Brandenburg, covering 667 hectares.

Small and very small water bodies dominate in terms of numbers. Berlin is home to a multitude of ponds, both artificial and natural, perennial and seasonal. It also features a number of quarry lakes and artificial rainwater retention basins. In total, 388 such water bodies are registered. They are joined by 316 drainage channels and ditches, some of which are piped, extending over a total length of more than 390 kilometres. These standing and flowing water bodies, small and very small in size, are predominantly managed and maintained by the city boroughs.

In Berlin, larger water bodies, such as rivers with catchment areas of more than 10 square kilometres and lakes exceeding 50 hectares, are subject to reporting under the European Water Framework Directive (WFD). Every six years, the European Commission requires updates on their ecological status and ecological potential, along with measures aimed at achieving a 'good ecological status'. Therefore, current efforts and studies are primarily focused on this reduced network of lakes and rivers in Berlin that fall under this Directive.

Approximately 200 kilometres of Berlin's flowing waters and ten lakes are monitored under the Water Framework Directive (WFD). Many of these flowing waters are manmade, such as canals and ditches. Type 21 'Flowing water discharging into a lake' is the most common type of flowing water also among natural water bodies, due to the prevalence of fluvial lakes. Additionally, substantial portions fall into Type 15 'Sandy lowland river', Type 14 'Sandy lowland stream', and Type 11 'Humic stream'. Smaller areas at the mouths of tributaries are classified as Type 19 'Lowland water body', while the Panke river, stretching from the Verteilerbauwerk, (tributary of the Nordgraben canal) to around Pankstraße, is classified as Type 12 'Gravelly lowland stream'. Some of these flowing waters transition between types, reflecting the natural longitudinal zonation of the rivers. For instance, the Spree changes type around the Elsenbrücke (at river km 22.05), shifting from a lowland river discharging into a lake to a sandy lowland river (SenUMVK 2021).

The lakes subject to reporting are mostly fluvial lakes with large catchment areas. They are classified as follows: the Großer Wannsee and Tegeler See are categorised as Type 10 'Stratified with a water residence time of more than 30 days'. Three other lakes fall into Type 11 'Unstratified with a water residence time of more than 30 days', and a further four lakes are classified as Type 12 'Unstratified with a water residence time of 3 to 30 days'. The Groß-Glienicke See, a non-fluvial lake, also remains stratified during the summer, meaning its warm surface layer stays separate from the colder deep water below. It is therefore classified as a Type 10 lake. Unlike lakes with inflows and outflows, the water in the Groß-Glienicke See has a theoretical residence time of seven years (SenUMVK 2021).

The various types of flowing water are a lot more alike in their current morphological state, than the classification might suggest. Additionally, the reduced network of water bodies under the WFD overlooks the smaller water bodies. Similar to previous overviews of Berlin's fish fauna, the present update is therefore based on a slightly different classification, which is, however, rather relevant when it comes to fish fauna. Flowing waters, canals, ditches, fluvial lakes, groundwater-fed lakes, and small standing water bodies of less than one hectare were classified based on their size, shape, connections, water sources, and potential as fish habitats.

The following section provides a brief overview of the main types of water bodies.

Flowing waters

The Spree, Havel, and Dahme are Berlin's three major navigable rivers, collectively spanning an impressive total of 88.6 kilometres within the city's boundaries. Among their key tributaries are the Fredersdorfer Mühlenfließ (3 km located in Berlin), the Neuenhagener Mühlenfließ (Erpe, 4.1 km), the Wuhle (15.7 km), the Panke (17.6 km), and the Tegeler Fließ (11.2 km), which discharges into the Tegeler See.

Berlin's flowing waters are flow-regulated. The water levels of the Havel and the lower Spree, for instance, are controlled by the Brandenburg barrage. During low water periods, the water surface almost levels out, with a minimal 0.16 metre difference (0.002‰ gradient) between Spandau and Brandenburg. At medium water levels, this gradient increases slightly to 0.006‰ (0.35 m difference), and during flooding, it peaks at 0.014‰ (0.83 m). Further on, the Mühlendamm dam and Kleinmachnow lock on the Teltowkanal regulate water levels in the upper Spree of the city and the Dahme, keeping them nearly at equal height. Even as the Spree continues its journey to the Unterspreewald, it overcomes a modest total height difference of 14 metres (0.08‰). Finally, the Charlottenburg barrage regulates the flow of the Stadtspree, the central segment of the river in the city.

As a result, the average flow velocities in Berlin's main flowing waters are relatively low, typically less than 10 centimetres per second. They can increase to over 0.5 metres per second during flooding with high discharge. In smaller tributaries, higher flow velocities are observed locally, particularly at former weir sites.

In terms of fish fauna, Berlin's main flowing waters are categorised as belonging to the lower reaches of the rivers, specifically the Bleiregion (bream region). It is characterised by carp-like species such as the white bream, bream, bleak and roach as the predominant types. These types of water bodies are among the more species-rich habitats in the city, although the current average count of fish species (16) highlights significant deficits. In total, 38 of the fish species found in Berlin have been observed in this water body type, at least as individual specimens.

Canals

Canals are artificially constructed waterways designed to connect water bodies. As a result, they are characterised by long, straight sections with few shallows or bends. The banks are fortified and rather steep, presenting a uniform appearance with marginal deviations in width, depth, and design over long distances. Berlin's navigable canals cover a total length of 80.1 kilometres and are primarily managed as federal waterways by the Wasserstraßen- und Schifffahrtsamt Berlin (WSA).

Moreover, Berlin's canals serve a crucial dual purpose: they act as vital outlets for treated wastewater and as overflow channels for combined sewerage systems. In 2022, three sewage treatment plants, Stahnsdorf, Ruhleben (which operates only between April and September and is scheduled for permanent closure upon completion of the UV disinfection system), and Waßmannsdorf, thus discharged approximately 758,000 cubic metres of treated wastewater into the Teltowkanal per day, totalling about 277 million cubic metres for the entire year (SenStadt 2022). The Landwehrkanal is connected to 72 combined sewer overflows from the BWB (Berlin Waterworks) (Abgeordnetenhaus Berlin 2020). During intense rainfall, when pumping stations can no longer cope with the volume of water they receive, a mix of untreated sewage and rainwater (at a ratio of roughly 1:9) flows into the water bodies. From 2015 to 2019, there were between 3 and 33 instances annually, releasing anywhere from 550,000 cubic metres (2015) to 3.419 million cubic metres of combined sewage into the Landwehrkanal (Abgeordnetenhaus Berlin 2020).

Due to their monotonous structure and relatively high pollution levels, the canals are predominantly home to hardy fish species that can tolerate these conditions. On average, around 15 different fish species inhabit these canals, with more than 90 % consisting of roach and perch. In total, 25 of Berlin's fish species have been recorded in the canals.

Ditches

The use of sewage farms for wastewater treatment began in 1876 and continued for a hundred years. The gradual increasing number of sewage farms prompted the creation of a dense network of inlet, outlet, and connecting ditches to service these fields. While most of the ditches dried up and were filled in after the sewage farms were permanently closed, there is still a large number of ditches that remain in Berlin to this day. These are small, minimally structured, and largely straight artificial flowing waters. About a quarter of the kilometres listed under ditches in Berlin's water directory, particularly in densely built-up areas, are piped and uninhabitable for fish. Most ditches today carry very little water, with average discharges ranging from 10 to 250 litres per second. In years with little precipitation, they can sometimes dry up completely or in parts. When they are not shaded, these ditches develop dense vegetation such as reeds, reed canary grass, and true sedges, which can occupy the entire cross section of a ditch. As a result, regular clearing and mowing of vegetation are essential to maintain these ditches.

They provide a crucial habitat, for example, for the two native stickleback species, namely the three-spined stickleback and the nine-spined stickleback. On average, they host about five different fish species. Therefore, it is rather surprising that a total of 28 distinct fish species have been documented in these ditches.

Fluvial Lakes

Fluvial lakes are a unique feature of the lowland rivers in northern Germany. These expansive lake-like extensions formed along river basins due to the gentle gradients of the rivers and their valleys, combined with the relatively young development history of the landscape. These fluvial lakes blend the characteristics of standing water habitats with the influence of flowing water in their inflow and outflow areas. Connected to other fluvial lakes by the rivers that flow through them, these water bodies also link to traditional river stretches and their characteristic flowing water habitats. As a result, these fluvial lakes support not only typical standing water fish species but also migratory species that come for spawning and river fish that periodically use the lakes for foraging.

With the exception of the Tegeler See, the large fluvial lakes in Berlin are relatively shallow, ranging in average depth from 2.1 metres (Großer Zug) to 5.4 metres (Großer Wannsee). They warm up quickly and are rich in nutrients, providing excellent conditions for the typical fish species of the Bleiregion to thrive and find ample food resources.

Fluvial lakes are the most biodiverse water body type in Berlin, hosting an average of 21 and a total of 37 confirmed fish species.

Groundwater-fed lakes

Larger water bodies (>1 ha), primarily sustained by groundwater with minimal or no water inflow or outflow, are classified as groundwater-fed lakes. Unlike fluvial lakes, these have much lower water exchange rates and often retain water for several years or decades on average. In addition to naturally occurring groundwater-fed lakes, many have been artificially created. They are often remnants of former quarry lakes used for resource extraction. Despite their different origins, both natural (12 species) and artificial (11 species) groundwater-fed lakes vary very little in their average number of fish species. This similarity is attributed to both types being equally affected by human activities such as fish stocking and surrounding land use. The difference in their overall diversity was therefore rather surprising: artificial groundwater-fed lakes support 25 species, whereas natural ones are home to 33 species.

These groundwater-fed lakes provide ideal conditions for fish species that typically thrive in nutrient-rich, seasonally warm standing waters.

Small Standing Water Bodies

This category encompasses all standing water bodies smaller than 1 hectare, whether natural or artificial. Like the larger groundwater-fed lakes, these small water bodies are influenced by various factors, making further differentiation impractical. The types of small water bodies, their shoreline structures, and the surrounding land uses vary widely, ranging from fully concreted rainwater retention basins and artificial park ponds to silted quarry ponds, and natural remnant water bodies. As a result, a diverse array of 32 fish species has been documented in these environments.

Due to their small size, each water body typically supports only a limited number of fish species, averaging around five. Among these, common standing water species such as tench and rudd, but also roach and pike, are prevalent.

European Directives

Implementing directives from the Council of the European Union involves meeting complex requirements regarding the quality and collection of fish stock data. For instance, Council Directive 92/43/EEC of 21 May 1992, known as the **'Habitats Directive'**, focuses on the conservation of natural habitats and of wild fauna and flora (Official Journal L 206). This EU Directive also includes Annex II, which details 'Animal and plant species of community interest whose conservation requires the designation of special areas of conservation' (last amended by Directive 2006/105/EC of the Council of 20 November 2006). Among these, Annex II also lists four fish species currently found in Berlin: bitterling, asp, weatherfish and loach.

The European Water Framework Directive (WFD), established on 23 October 2000, was the first European regulation to use fish fauna as a biological element for assessing the ecological status of water bodies. The Directive's approach for evaluating the ecological status of lakes and rivers is based on **composition, abundance and age structure of the fish fauna** as well as the presence of species sensitive to disturbances. The goal of the WFD was to achieve **good ecological status** for all surface waters, and good ecological potential for artificial and heavily modified water bodies by 2015. However, since these targets were not met by 2015, a second extension of the deadline to 2027 has already been adopted. Results from monitoring programmes under both the Habitats Directive and the WFD continue to inform the Environmental Atlas.

Statistical Base

Between 2014 and 2022, fish surveys were conducted in 153 water bodies. Each water body was fished at least once during this period. Larger bodies of water, especially those requiring regular updates under the WFD, underwent multiple surveys at different sampling points.

Electric fishing was the main technique used. Fishing followed approved methodological principles, typically using direct current (DC) generators. Portable, battery-operated devices were used for wadeable ditches and small water bodies, while larger ones were surveyed from boats equipped with more powerful generator-operated devices. DC generators create an electric field in the water, which influences fish based on their length and position relative to the field lines. Fish responses can range from fleeing to positive electrotaxis (swimming toward the anode) or even electronarcosis, depending on the voltage they encounter. The effective capture range of the electrode is about 2 metres.

When implemented correctly, electrofishing is the least disruptive method for surveying fish populations because it minimises contact with netting and similar materials used in other methods. With electrofishing, fish sustain minimal injuries to scales or mucous membranes. It is also the most effective method for fishing in rough soil substrates featuring rocks, riprap, or vegetation. As a result, electrofishing has become the standard method for assessing fish populations under the WFD in flowing waters.

The length of each fishing section ranged from 300 to 3,000 metres of shoreline, depending on the width of the water body, the complexity of structures, and the fishing success rate. The goal was to obtain the most comprehensive picture of the species range possible. However, pelagic (open water) species and large, elusive individuals of all fish species are often underrepresented in electrofishing. These fish can evade the effective capture field because their flight distance exceeds the anode's range, resulting in them being caught only incidentally. Overall, electrofishing has a much lower selectivity compared to other methods, even when similar effort and time are invested.

In addition to electrofishing, multi-mesh gillnets were used in groundwater-fed lakes to catch fish swimming in open water, which are methodologically underrepresented in electrofishing. Gillnets operate on the principle that a fish attempting to swim through the net becomes trapped (gilled) in the mesh, enclosing its body tightly enough to prevent escape. The nets capture fish best when their body circumference is about 25 % larger than the mesh size, which only applies to a narrow range of fish lengths. Gillnets therefore have a high degree of size selectivity. The chosen mesh size determines both the size range of fish and, to some extent, the range of species that can be caught.

Multi-mesh nets are made up of panels with varying mesh sizes, allowing them to capture a broader range of fish sizes compared to nets with a uniform mesh size. In the open-water surveys of Berlin's groundwater-fed lakes, 30-metre-long and 1.5-metre-high multi-mesh bottom-set gillnets were employed. The number of nets used was adjusted based on the size of each water body. Each net consisted of 12 panels, with mesh sizes of 5, 6.25, 8, 10, 12.5, 15.5, 19.5, 24, 29, 35, 43 and 55 millimetres. To minimise harm to the fish, the nets were deployed for a maximum of two hours.

In fluvial lakes and large flowing waters, the Fischereiamt Berlin (Fisheries Office) also used trawls. The IBG (Institute of Freshwater Ecology and Inland Fisheries) did the same in the Großer Müggelsee. Similar to gillnetting, this approach aimed to survey open-water fish species, which are often under-represented in electrofishing surveys. Unlike gillnets, which only catch fish when they try to swim through them, trawls are actively pulled through the water, also capturing inactive fish. While trawls are better suited for assessing the abundance of open-water fish, they require significantly more technical effort compared to gillnets.

In August 2004, the Fischereiamt Berlin launched the research vessel 'PISCATOR', which has since been regularly used for trawling, among other activities. A trawl is a large net bag with wings, towed behind the boat and kept open by trawl doors. The mesh size of the net bag (the 'cod-end') determines the shortest length of the fish caught, with little size selectivity beyond that. The Fischereiamt used various trawls of different designs and mesh sizes in the net bag. The trawl lengths varied between a few hundred metres and two to three kilometres. Every two years, the IGB uses the research vessel 'Paulus Schiemenz', launched in 2011, for trawling as part of the fish monitoring at the Müggelsee.

Using various types of devices helps account for differences in selectivity, making the recordings more representative of the actual fish stocks and, in particular, the species present. These surveys were supplemented by qualitative insights from commercial fishers, who shared observations, such as a notable catch of a sea trout in the Unterhavel on 15 February 2017. Additionally, data from the Stiftung Naturschutz (Foundation for Nature Conservation) provided valuable information on unusual by-catches, primarily non-native species like the goldfish and the pumpkinseed.

All catches are typically analysed by identifying, counting, and measuring all captured fish, along with weighing random samples. When large numbers of fish from a specific age or size group are encountered, a representative sample is measured, while the remaining specimens are only counted. This approach minimises handling time and allows for faster release, reducing stress on the fish.

The present analysis examines the fishery data from the Fischereiamt Berlin with a focus on water bodies. An additional brochure, featuring an up-to-date analysis specifically centred on fish species, will be published in 2024.

Map Description, Fish Species Composition, and Main Fish Species

A total of 40 different fish species were documented in Berlin's water bodies during the analysis period from 2014 to 2022. The present map description focuses on this time span. The brochure 'Fische in Berlin' (Fish in Berlin) encompasses all data, including that collected before this period.

Fourteen of the fish species recorded prior to end of 2022 were non-native, known as neozoa. Among them, for the first time this year, is the gibel carp, which was previously listed as native. Recent studies revealed, however, that every single historical record and specimen of the gibel carp, including those in the Berliner Naturkundemuseum (museum for natural history), turned out to be or depict crucian carps. It appears the gibel carp was likely introduced to Germany only after 1945, leading to its reclassification as a non-native species (Freyhof et al. 2023). Since the last edition was published in 2013, several new species have been documented. These comprise the Siberian sturgeon, a single specimen found in the Obersee lake in 2017; the round goby, which has been established in major flowing waters since 2015; and the marbled goby, first recorded in the Großer Müggelsee in 2022. On the other hand, the brook

trout and the golden orfe have not been documented since 2013. In 2003, it was still believed that both species of bullhead were present in Berlin's water bodies, given the brown bullhead's presence in the Lusatia region and the catchment area of the Schwarze Elster river. This was not confirmed by the current survey, however, which only found black bullheads (*Ameiurus melas*). New sightings of other non-native fish species generally involved only a few specimens or a single individual, except in the case of the round goby. Nonetheless, non-native fish populations continue to decline, except for gobies, the gibel carp, and the pumpkinseed.

Apart from the gibel carp, non-native fish species are generally quite rare in Berlin. The gibel carp is the most common non-native species, recorded in 26.8 % of all surveyed water bodies between 2014 and 2022. Following the gibel carp is the goldfish, the most prevalent among the rare neozoa, appearing in 13.1 % of Berlin's water bodies. Next is the rapidly spreading round goby, which was spotted in 11.8 % of the surveyed areas. Three non-native species, the Siberian sturgeon, the marbled goby, and the brook trout, were each found in only one water body. Overall, non-native species are less common in Berlin's compared to native fish, with a few exceptions. Among the native species with only a few recorded sightings or occurrences are the stone loach, the vimba bream, the nase, and the sea trout.

Overall, the roach stands out as the most prevalent fish species in Berlin, recorded in 66 % of water bodies surveyed between 2014 and 2022. Trailing closely are the perch, found in 57.5 % of the water bodies, followed by the rudd (52.9 %), the pike (49 %), and the tench (40.5 %). Pike are notably abundant in smaller water bodies, where individual specimens are found in almost all of them. The eel's frequent presence is due to extensive stocking efforts and does not reflect water quality. Conversely, the widespread occurrence of the roach, the perch, the ruffe, the bream, the rudd, the white bream, and the bleak in flowing waters and fluvial lakes highlights their remarkable adaptability to Berlin's aquatic environments. With the exception of the rudd, these species are eurytopic and classified as adaptable, with no specific habitat requirements. Their prevalence also underscores the extent to which Berlin's main flowing waters have changed: once characterised by the barbel, they are now dominated by the bream (Bleiregion).

When interpreting the results in Table 1, it is essential to recognise that the water bodies examined varied between investigation periods. Therefore, the table offers no insight into fish stocks or shifts in occurrences within individual water bodies.

Tab 1: Occurrence and endangerment of recorded fish species in 1993, 2003, 2013, 2022

		Occurrence in 1993		Occurrence in 2003		Occurrence in 2013		Occurrence in 2022				
Number of water bodies examined		151		170		153		153				
Fish species		Number of water bodies with record of species	Percentage of water bodies with record of species	Number of water bodies with record of species	Percentage of water bodies with record of species	Number of water bodies with record of species	Percentage of water bodies with record of species	Number of water bodies with record of species	Percentage of water bodies with record of species	Threat category as per Red List of Berlin, 2023	Threat category as per Red List of Germany, 2023	Habitats Directive Annex
Eel	Anguilla anguilla (Linnaeus, 1758)	86	57.0	99	58.2	76	49.7	32	20.9	Not Evaluated	Not Evaluated	-
Ide	Leuciscus idus (Linnaeus, 1758)	32	21.2	43	25.3	38	24.8	9	5.9	Not Threatened (*)	Not Threatened (*)	-
Brook trout	Salvelinus fontinalis (Mitchill, 1814)					1	0.7				Neozoa	
Perch	Perca fluviatilis Linnaeus, 1758	100	66.2	115	67.6	103	67.3	88	57.5	Not Threatened (*)	Not Threatened (*)	-
Bitterling	Rhodeus amarus (Bloch, 1782)	10	6.6	2	1.2	17	11.1	10	6.5	Threatened (3)	Not Threatened (*)	II
Stone moroko	Pseudorasbora parva (Temminck & Schlegel, 1846)					2	1.3	3	2.0		Neozoa	
Bream	Abramis brama (Linnaeus, 1758)	88	58.3	96	56.5	72	47.1	53	34.6	Not Threatened (*)	Not Threatened (*)	-
Chub	Leuciscus cephalus (Linnaeus, 1758)	15	9.9	7	4.1	7	4.6	3	2.0	Threatened (3)	Not Threatened (*)	-
Three-spined stickleback	Gasterosteus aculeatus Linnaeus, 1758	58	38.4	59	34.7	28	18.3	15	9.8	Not Threatened (*)	Not Threatened (*)	-
Trout	Salmo trutta (Linnaeus, 1758)							3	2.0	Highly threatened (2)	Threatened (3)	
Pumpkinseed	Lepomis gibbosus (Linnaeus, 1758)					5	3.3	17	11.1		Neozoa	
Gibel carp	Carassius gibelio (Bloch, 1782)	63	41.7	66	38.8	52	34.0	41	26.8		Neozoa	
Goldfish	Carassius auratus (Linnaeus, 1758)	10	6.6	9	5.3	9	5.9	20	13.1		Neozoa	
Golden orfe	Leuciscus idus auratus (Bade, 1901)					1	0.7				Neozoa	
Grass carp	Ctenopharyngodon idella (Valenciennes, 1844)	18	11.9	6	3.5	3	2.0	3	2.0		Neozoa	
Gudgeon	Gobio gobio (Linnaeus, 1758)	48	31.8	47	27.6	49	32.0	23	15.0	Threatened (3)	Not Threatened (*)	-
White bream	Abramis bjoerkna (Linnaeus, 1758)	74	49.0	79	46.5	47	30.7	26	17.0	Near threatened (V)	Not Threatened (*)	-
Dace	Leuciscus leuciscus (Linnaeus, 1758)	12	7.9	12	7.1	12	7.8	3	2.0	Highly threatened (2)	Not Threatened (*)	-
Pike	Esox lucius Linnaeus, 1758	84	55.6	98	57.6	104	68.0	75	49.0	Not Threatened (*)	Not Threatened (*)	-
Crucian carp	Carassius carassius (Linnaeus, 1758)	85	56.3	69	40.6	52	34.0	40	26.1	(2)	(2)	-
Carp	Cyprinus carpio Linnaeus, 1758	75	49.7	77	45.3	25	16.3	17	11.1	Not Threatened (*)	Not Threatened (*)	-
Ruffe	Gymnocephalus cernuus (Linnaeus, 1758)	60	39.7	71	41.8	42	27.5	19	12.4	Not Threatened (*)	Near threatened (V)	-
Marbled goby	Proterorhinus semilunaris (Heckel, 1837)							1	0.7		Neozoa	
Marbled carp	Hypophthalmichthys nobilis (Richardson, 1845)			4	2.4	1	0.7	2	1.3		Neozoa	
Moderlieschen	Leucaspius delineatus (Heckel, 1843)	41	27.2	47	27.6	48	31.4	27	17.6	Not Threatened (*)	Not Threatened (*)	-
Nase	Chondrostoma nasus (Linnaeus, 1758)							1	0.7	Extremely rare (R)	Near threatened (V)	
Roach	Rutilus rutilus (Linnaeus, 1758)	102	67.5	116	68.2	111	72.5	101	66.0	Not Threatened (*)	Not Threatened (*)	-
Burbot	Lota lota (Linnaeus, 1758)	20	13.2	21	12.4	12	7.8	4	2.6	Threatened with Extinction (1)	Highly threatened (2)	-
Asp	Aspius aspius (Linnaeus, 1758)	34	22.5	36	21.2	32	20.9	10	6.5	Not Threatened (*)	Not Threatened (*)	II, V
Rainbow trout	Oncorhynchus mykiss (Walbaum, 1792)	17	11.3	4	2.4						Neozoa	
Rudd	Scardinius erythrophthalmus (Linnaeus, 1758)	78	51.7	93	54.7	93	60.8	81	52.9	Not Threatened (*)	Not Threatened (*)	-
Weatherfish	Misgurnus fossilis (Linnaeus, 1758)	8	5.3	5	2.9	13	8.5	3	2.0	(2)	Threatened (3)	II
Tench	Tinca tinca (Linnaeus, 1758)	80	53.0	95	55.9	89	58.2	62	40.5	Not Threatened (*)	Not Threatened (*)	-
Stone loach	Barbatula barbatula (Linnaeus, 1758)					1	0.7			Threatened with Extinction (1)	Not Threatened (*)	-
Round goby	Neogobius melanostomus (Pallas, 1814)							18	11.8		Neozoa	
Siberian sturgeon	Acipenser baerii (Brandt, 1869)							1	0.7		Neozoa	
Silver carp	Hypophthalmichthys molitrix (Valenciennes, 1844)	15	9.9	7	4.1	4	2.6	4	2.6		Neozoa	
Loach	Cobitis taenia Linnaeus, 1758	3	2.0	10	5.9	13	8.5	12	7.8	Near threatened (V)	Not Threatened (*)	II
Smelt	Osmerus eperlanus (Linnaeus, 1758)	13	8.6	10	5.9	15	9.8	7	4.6	Near threatened (V)	Highly threatened (2)	-
Bleak	Alburnus alburnus (Linnaeus, 1758)	61	40.4	75	44.1	56	36.6	35	22.9	Not Threatened (*)	Not Threatened (*)	-
Catfish	Silurus glanis Linnaeus, 1758	18	11.9	28	16.5	10	6.5	11	7.2	Not Threatened (*)	Not Threatened (*)	-
Pike-perch	Sander lucioperca (Linnaeus, 1758)	60	39.7	60	35.3	32	20.9	18	11.8	Not Threatened (*)	Not Threatened (*)	-
Nine-spined stickleback	Pungitius pungitius (Linnaeus, 1758)	19	12.6	19	11.2	13	8.5	7	4.6	Near threatened (V)	Not Threatened (*)	-
Brown bullhead	Ameiurus nebulosus (LeSueur, 1819)	3	2.0	3	1.8	2	1.3	2	1.3		Neozoa	

Tab 1: Occurrence and endangerment of recorded fish species in 1993, 2003, 2013, 2022

The occurrence of fish species in the main water body types, as presented in the table, also provides valuable insights into their habitat preferences.

For instance, species typically found in rivers, such as the gudgeon, the ide, and the asp, occurred in only about 19 % of all water body types, but were present in at least 67 % of fluvial lakes. Similarly, the pike-perch, the smelt, the burbot, and the catfish were predominantly recorded in fluvial lakes.

The detailed presentation of fish species across different water body types highlights three distinct biodiversity groups. From 2014 to 2022, fluvial lakes emerged as the most biodiverse group, as expected, with an average of 13 fish species. They were followed by large flowing waters, which averaged 9 species, and canals, with 4 species. Although they display similar species counts, groundwater-fed lakes, whether artificial or natural, fall into the middle group with 6 species on average. In contrast, small water bodies, whether flowing or standing, had the fewest species, averaging just 4 per ditch or small standing water body. However, the range in biodiversity among small flowing water bodies (15 species, including 2 neozoa) and standing water bodies (26 species, including 7 neozoa) indicates that species composition varies greatly here and is highly unpredictable. The category of smallest water bodies, whether flowing or standing, consistently had the lowest number of fish species.

Compared to small water bodies, urban canals displayed a relatively low total number of fish species. This suggests that fish in these canals may resort to compensatory migrations to escape unfavourable environmental conditions when possible.

Tab. 2: Number of Berlin's water bodies in which recorded fish species occur (2014 –2022)									
No. on the Map	Fish species	Water body type							Total
		Fluvial lakes	Groundwater-fed lakes		Small water bodies	Flowing water bodies	Canals	Ditches	
			nat.	artif.					
		Number of water bodies examined							
		18	30	8	71	13	4	9	153
01	Burbot	3						1	4
02	Crucian carp	3	4	3	28	2			40
03	Weatherfish		1			1		1	3
04	Dace	1				2			3
05	Trout	2				1			3
06	Bitterling	2	2	1	3	2			10
07	Chub	2				1			3
08	Gudgeon	7	5		4	5		2	23
09	Nase	1							1
10	White bream	12	1	1	8	2		2	26
11	Loach	9				3			12
12	Smelt	7							7
13	Nine-spiked stickleback					3		4	7
14	Ide	6				3			9
15	Perch	17	24	8	26	10	1	2	88
16	Bream	15	18	2	9	6	1	2	53
17	Three-spined stickleback	4			2	4		5	15
18	Pike	10	24	7	22	7	1	4	75
19	Carp	3	1		12	1			17
20	Ruffe	14			1	4			19
21	Moderlieschen	1	11		15				27
22	Roach	17	28	7	35	10	1	3	101
23	Asp	7			1	1	1		10
24	Rudd	11	25	4	32	5	1	3	81
25	Tench	8	16	3	25	5	1	4	62
26	Bleak	12	7	2	7	5	1	1	35
27	Catfish	8	2		1				11
28	Pike-perch	15			1	2			18
29	Eel	15	4	1	3	8	1		32
30	Stone moroko				3				3
31	Gibel carp	3	4	2	25	3	1	3	41
32	Goldfish		3	2	13	2			20
33	Grass carp	2			1				3
34	Marbled carp	2							2
35	Silver carp	4							4
36	Pumpkinseed	3	1	2	7	3	1		17
37	Brown bullhead				2				2
38	Marbled goby	1							1
39	Round goby	10			1	3	3	1	18
40	Siberian sturgeon		1						1
	Total	34	20	14	26	28	12	15	40

Tab. 2: Occurrence of recorded fish species in Berlin's water bodies (2014 - 2022)

Red List of Fish and Lampreys of Berlin

The threat status of plants and animals has been recorded in Red Lists of threatened species for over four decades. Although these lists are not legally binding, they are an established tool in conservation practice, guiding landscape planning, impact assessment, and nature and species conservation. The basic idea is relatively simple. Species with highly specific environmental requirements or those that are very sensitive to interference are usually the first to be affected by disturbances. This leads to their decline or disappearance from an area. Conversely, the presence of threatened species in an area suggests that even sensitive species may still find suitable conditions to live in, which is a positive sign. For fish especially, the status of a threatened species' population can indicate the quality of the water habitat.

The larger the area covered by a Red List and the greater the threat to a species, the more valuable and widely important their populations are considered in species conservation. Red Lists are helpful for assessing environmental impacts because they are regularly revised and updated with the latest population data. They also provide a clear and reliable classification of species.

The fourth update of the Red List of fish and lampreys, discussed here, evaluates the current threat levels of native fish species in Berlin's water bodies. The 2023 update (available as a brochure) builds on previous versions: the initial Berlin-wide list from 1993 (Wolter et al. 1994), as well as updates from 2003 (Wolter et al. 2003) and 2013 (Wolter & Schomaker 2013). It uses the same uniform system applied throughout Germany and the same classification criteria established by Ludwig et al. (2006) for categorising threatened species, ensuring that changes in threat levels of species can be directly compared.

The regional Red List of fish and lampreys of Berlin is rather specialised, focusing on a small and highly urbanised area. It only records and assesses fish populations in parts of the Spree-Havel system, which is somewhat of a disadvantage. However, the study of fish populations, including those of sensitive species, in these urban water bodies offers important insights into the ecological potential of highly modified environments. It helps to understand the resilience and development potential of fish species, and to identify the most effective strategies to restore these waters.

Berlin's fish fauna comprises 50 species of lampreys and fish, of which 37 are native. Today, all three native lamprey species and five native fish species are either extinct or lost. In total, nine species are currently threatened, representing 24.3 % of the fish fauna. When including the extinct fish species, nearly half of Berlin's original fish fauna, 45.9 % of the native species, are either lost or threatened. Additionally, the nase, an extremely rare species, has been recorded only once in the Großer Müggelsee. At present, 15 species, or 40.5 %, are not threatened.

The analysis of short-term population trends is quite concerning, as it is dominated by declining fish populations. This primarily affects species that live in small water bodies, especially the crucian carp. The weatherfish and species that favour cooler water, such as the dace, ruffe, and burbot, are also affected. The effects of climate change, which are already considerable in urban areas, are becoming increasingly palpable here.

Overall, the positive development of Berlin's fish populations, which was attributed to the improved water quality, has come to a standstill and thus reflects the national trend (Freyhof et al. 2023). While population trends remain stable for most species, many have not yet regained their former distribution and abundance, and some are even starting to decline again. As water quality is no longer a limiting factor, targeted efforts to improve aquatic structures important to the life cycle of river fish, such as gravel spawning grounds and nursery habitats, are needed to promote fish biodiversity and restore populations.

Similarly, the overall balance compared to the 2013 Red List of fish in Berlin has deteriorated. While only six species were listed with a threat level in 2013, this number has now increased to nine. After a brief improvement in 2013, when the threat level of eleven species was downgraded from the previous list (Wolter et al. 2003), the current Red List shows only reclassifications to higher threat levels, as seen with the gudgeon, dace, and burbot. No species has been downgraded.

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