KAMPINOSKIE BAGNA 2

KAMPINOS WETLANDS HANDBOOK

Edited by Anna Andrzejewska and Michał Miazga

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REGIONALNE CENTRUM EKOLOGICZNE
REC Polska

Kampinoski Park Narodowy

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Contents

WILD FOREST

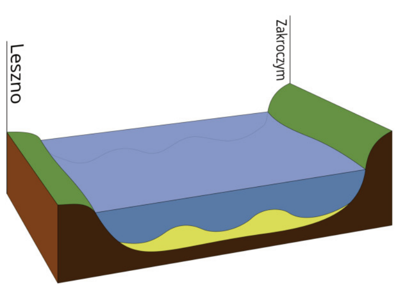
How the Kampinos Wetlands Came to Be

↑ This is roughly what the initial phase of landform formation in the Kampinos Forest looked like around 14,000 years ago. At the time, the Vistula River reached 15 km in width. (photo: karolcichon.pl/Shutterstock.com)

The land profile of the Kampinos Forest is inseparably linked with the ancestral Vistula (Prawisła – end-of-Ice Age predecessor of the Vistula River). During the last glaciation, this large river collected water from all over southern and eastern Poland, as well as water flowing from the ice sheet covering the northern part of the country and flowed to the North Sea. At that time, the Prawisła first eroded a deep valley and then filled it with sands and gravels. However, the climate was gradually getting warmer, the ice sheet was melting and moving northwards, and there was less and less water. Just as today sandbanks form on the Vistula in times of drought, at that time large sandy dry islands were formed, separated by river currents. The wind carried the loose sand away, forming numerous dunes which moved from west to east. This is how the present dune belts of the Kampinos Forest were formed.

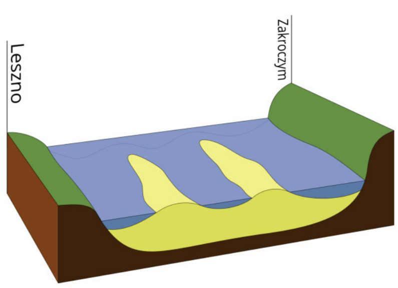
↓ History of the formation of the present-day relief of the Kampinos Forest. It is worth comparing the width of the Prawisła River (ancestral Vistula) 20,000 years ago with the present Vistula River (by Anna Andrzejewska, Andrzej Pachowski)

circa 20,000 years ago



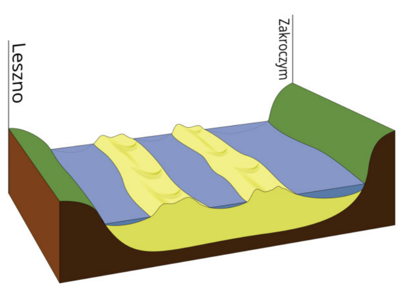
During the last glaciation, the Vistula River filled the entire valley with water.

circa 14,000 years ago



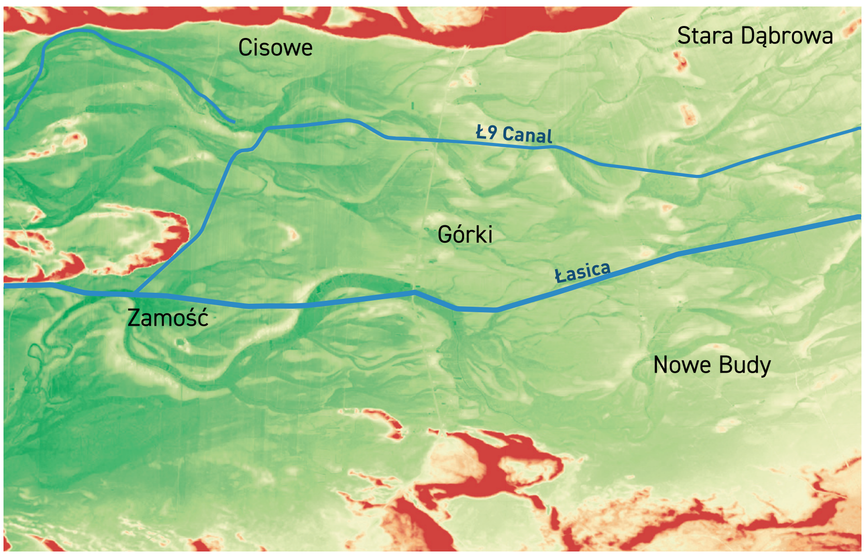
During the period of climate warming, the Vistula riverbed filled with sand and gravel. Sandbanks emerged from the receding water.

circa 12,000 years ago



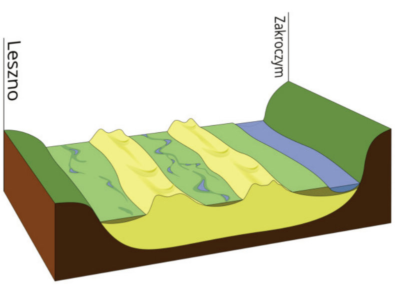
Water kept receding. Wind formed dunes on the emerging sandbanks.

At the same time, the former riverbeds of the Vistula between these islands held water at first, but later only small streams remained, meandering, splitting and reuniting to form the complex micro-landform, resembling braid-like twists, that can be seen today, especially in the northern wetland belt of the Kampinos Forest. With time these braided depressions filled with organic matter and water flowed through them only during thaws and heavy rainfall. For most of the year, the flow almost disappeared, creating favourable conditions for the development of wetland vegetation. All this resulted in there being almost no natural watercourses in today's forest. They have developed only where water from the wetlands broke through a dune belt, as in the case of Wilcza Struga and a watercourse in the Roztoka region (the latter was called Mustogoszcz in the Middle Ages), and where water flowed into the Kampinos Forest from outside, such as today's river Struga, formerly known as the Rgilewnica, or the Lipkowska Woda flowing into it.



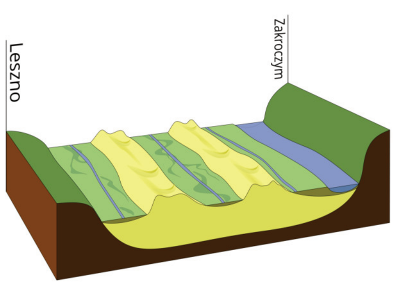
↑A section of the hypsometric map of Kampinos Forest. Dark green colour indicates visible braided and meandering depressions indicative of former water flows. (©Karolina Bukowiecka)

circa 10,000 years ago



The Vistula reached a width similar to the current one. Peatland began to form in the dried-up riverbeds. The water flowed off through braided depressions.

circa 200 years ago



Man began to dig channels and ditches to drain the water in the peatlands. This led to the drainage of wetlands.

SILTS, PEATS AND OTHER SOIL-FORMING HABITATS

Over the millennia, dead plant remains accumulated on the wetland belts, forming an increasingly thick organic layer. Peats were formed in permanently flooded areas, while in those periodically flooded silt emerged. In the areas where water was only occasionally present, soil-forming habitats with periodically high levels of water emerged.

These differ from each other in thickness and in the degree of preservation of organic matter, which (especially the peats) slowed down the outflow of water and retained it like a sponge. Originally, peatlands covered 33% of the wetland belts, while soil-forming habitats with significant fluctuations in water levels or with periodically high levels of water covered as much as 47% of the area. This demonstrates the constant fluctuation of water levels in this area over the last millennia. Perhaps this is attributable to the permeability of the local soils and the impact of fluctuations in the water level of the Vistula. Confirmation of this theory is provided by the relatively low thickness of the Kampinos peats, which currently averages about 90 cm, although in some places there are peats up to 4 m thick.

↑ A fertile bog resembles a sponge. Water is retained both in the tissues of peat moss and between the plants. (photo: Anna Andrzejewska)

↑ Lipkowska Woda in Lipków – a natural rivulet flowing from Warsaw into the Kampinos Forest. (photo: Anna Andrzejewska)

Where Does the Water Come from in Kampinos Forest?

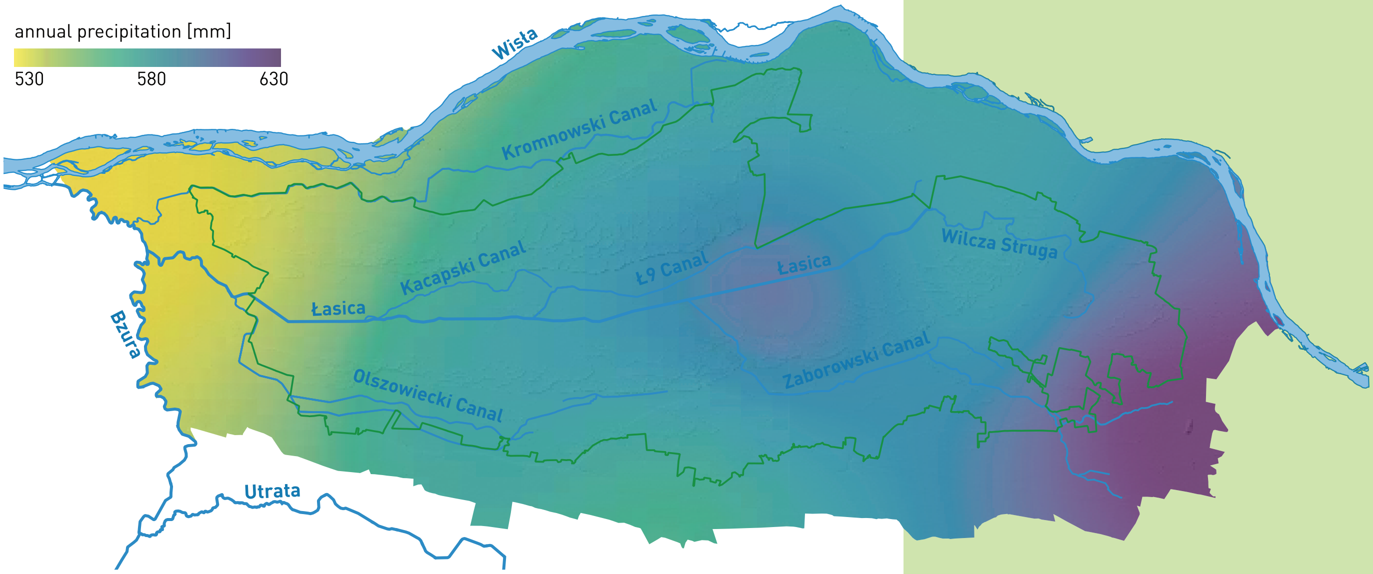
↑ Meteorological station in the village of Granica near Kampinos. Since 1994 measurements of precipitation, air temperature, wind direction and speed, and of many other parameters have been carried out here. (photo: Anna Andrzejewska)

↑ A drainage ditch in the vicinity of Zaborów. Before flowing into the Kampinos Forest, the water from this ditch is cleansed of fertiliser residues and other pollutants in the ponds in Zaborów and in several beaver pools. This is very beneficial for the Kampinos wetlands. (photo: Michał Miazga)

The main source of water in today's Kampinos Forest is precipitation. Almost all the water that is present here - whether it flows through the forest's canals, feeds the soil and vegetation, or remains below the ground surface - comes from rain and snow. A water column of approximately 580 mm (580 l/m2) falls annually on the Puszcza Kampinoska area. This amount varies from year to year. Wet years record up to twice as much rain as dry years. Spatial variation in rainfall is also significant. Each year, about 20% more water falls in the eastern and central parts of the Forest compared to the western part. This is mainly due to the influence of the Warsaw agglomeration. Above urban areas, the air heats up faster than outside the city, creating an urban heat island. The heated urban air rises upwards. The same happens at the border between forest and city with the moist air from above Kampinos. When it reaches the higher, cooler layers of the atmosphere, the water vapour contained in the air condenses. Rain clouds are formed, which stop over the Kampinos Forest close to Warsaw. This is why the area receives more precipitation, especially heavy rain during summer storms.

Of relatively minor importance for the Kampinos Forest is the water supply from the few watercourses flowing into it. Most water from outside reaches the forest through natural watercourses and ditches from the south and south-east from the Łowicz-Błonie Plain. Treated water from the surrounding sewage treatment plants also enters the area. Even less important are the few springs located at the foot of the Łowicz-Błonie Plain, for instance in the vicinity of Korfowe. In addition, groundwater in the area of the forest, in the Vistula proglacial valley, is fed by waters seeping from the Łowicz-Błonie Plain.

Distribution of precipitation in the Kampinos Forest in the years 2001-2023. Most rain falls in the eastern part of the forest on the border with Warsaw, and the least in the west.
(©Anna Andrzejewska)



Annual precipitation in the Kampinos Forest in the station at Granica village in the years 2001-2023
(©Anna Andrzejewska)

WATER MONITORING IN THE KAMPINOS NATIONAL PARK

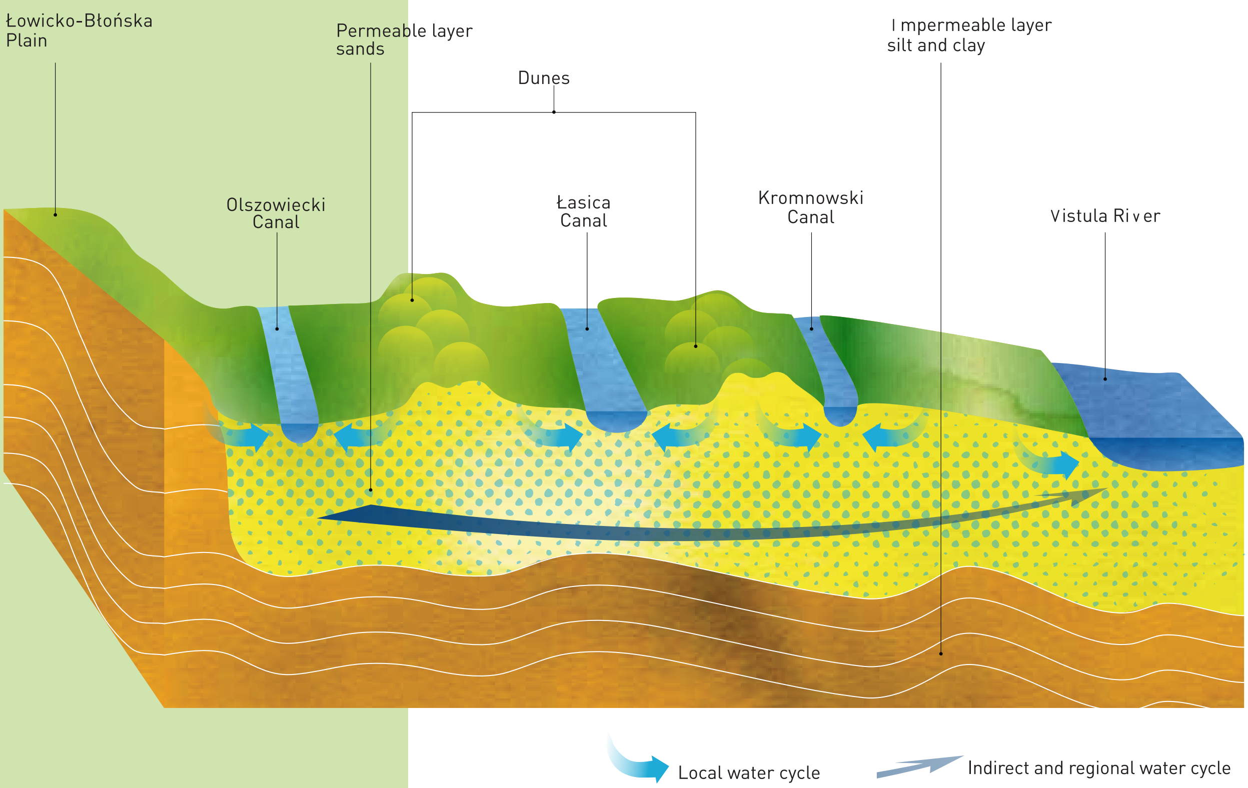
For many years in the park, measurements have been carried out to gain a thorough understanding of the water cycle in the area. The amount of precipitation is measured daily at 9 locations. Groundwater levels are analysed at 57 sites located in the Kampinos Park and the buffer zone. These measurements are taken by park staff once every fortnight. The surface water level is also systematically monitored. Water levels in the main canals of the forest are measured at 20 locations.

Many additional monitoring activities are carried out as part of the 'Kampinos Wetlands' and 'Kampinos Wetlands 2' projects. Both the rate of water flow in the different sections of the canals, the permeability of the canal beds and their impact on the groundwater resources in the area are assessed.

← Rainfall is the most important source of water for Kampinos wetlands. (photo: Anna Andrzejewska)

Where the Kampinos Forest Water Disappears

Diagram of groundwater and surface water circulation in Kampinos National Park



Water that finds its way into the forest can evaporate, run off through watercourses or soak into the ground. Years of research show that most water disappears from the Kampinos Forest because of evaporation (over 80%), much less runs off through watercourses, and soaking in is only of symbolic importance. Due to the temporal variation of air temperature, evaporation is much greater in summer than in winter. This means that in the six-month period that includes summer, evaporation (approx. 400 mm) exceeds precipitation (approx. 300 mm), and in the winter the opposite is true: precipitation (approx. 250 mm) is greater than evaporation (approx. 100 mm).

↓ The water flow is subject to very strong fluctuations; the flow occurring in spring (April and May) often disappears completely in late summer (September) - pictured is Łasica Canal in Nowa Dąbrowa in 2022. (photo: Anna Andrzejewska)

↑ April

↑ May

↑ September

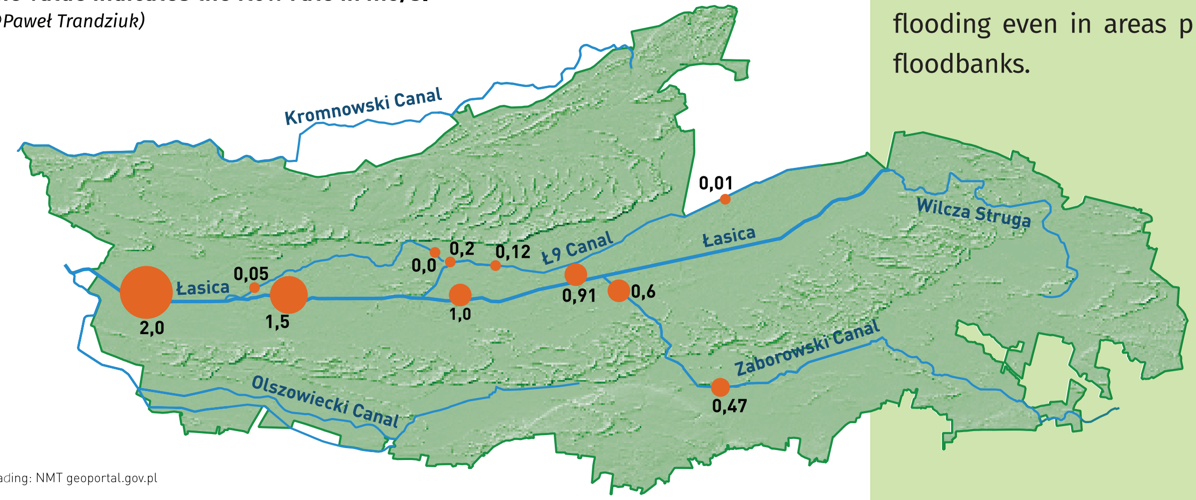
(This comparison of precipitation and evaporation explains why the water level in the Kampinos Forest drops rapidly in summer and starts to rise from late autumn onwards.

Approximately 20% of rainwater flows out of the Kampinos Forest through canals, with a significant difference between the summer and winter. In the former, almost three times less water flows out compared to the winter, despite precipitation being much higher then. The reason for this is the aforementioned higher evaporation in summer.

Water soaking into the ground is of little importance for runoff from the Forest. In general, the amount of water soaking into the ground balances with the amount of groundwater flowing in. However, some areas in the forest,—primarily on dunes—are dominated by water soaking into the ground, while others—mainly in wetland depressions—are characterized by groundwater recharge.

↑ Flooded meadow at a time when rainfall exceeds evaporation (photo: Anna Andrzejewska)

Flow in the watercourses of the Kampinos National Park in May 2021. The value indicates the flow rate in m3/s.
(©Paweł Trandziuk)



shading: NMT geoportal.gov.pl

GROUNDWATER CIRCULATION

Where the Kampinos Forest grows today, there was once the Vistula riverbed. The river brought a thick layer of sand here. This layer is easily permeable, which means that there is continuous water movement beneath the ground surface. The fine impermeable interlayers present in the sand layers and the varied sources of water supply mean that water at different depths can move in diverging directions. Shallow groundwater is dependent on the relief (dunes and depressions) and the network of watercourses and canals. It seeps into surface water and then flows to the Bzura and Vistula rivers. Excess water in this system manifests itself on land in the form of flooding, while shortages of water result in the drying up of watercourses. Deeper waters bypass the local watercourses and flow independently from the Łowicz-Błonie Plain northwest towards the Vistula, forming an intermediate and regional circulation system. Fluctuations in the level of the Vistula can affect water levels within the Kampinos Forest, but this occurs within a limited area. On the other hand, during floods on the Vistula, the outflow of groundwater from the forest is impeded, which can cause flooding even in areas protected by floodbanks.

How Beavers Changed the Kampinos Forest

↑ A beaver pond near Lipków. Such sites enable the survival of many plant and animal species dependent on aquatic habitats. (photo: Michał Miazga)

Beavers have an enormous impact on the wildlife of the wetland belts of the forest. They are the only creature, apart from humans, which can build dams and fell trees, increasing the area of non-forest habitats. They are also the largest of the 16 rodent species living in the Kampinos National Park.

Currently between 23 and 25 beaver families thrive in the Kampinos Forest. They mainly inhabit the largest canals. They live in burrows, bank-lodges, and open water lodges, which at times reach considerable dimensions. The main factors limiting their numbers are lack of food, lack of water, and recently also the presence of wolves. The Kampinos' beavers build low-rising dams, usually impounding up to several dozen centimetres of water. Nevertheless, in terrains as flat as wetland belts in the Kampinos Forest, these structures can impact an area of several hundred metres or as high as one kilometre. Through the construction of impounding structures beavers raise and stabilize the level of groundwater and surface water, thus increasing water retention. Maintaining a stable, high level of water inhibits the decomposition of peat, which is of utmost importance for wildlife. It allows nutrients to be retained in the ground as their excess is damaging for many

↑ A more than two-metre-high beaver lodge on Zaborowski Canal. Winter 2020/2021 (photo: Michał Miazga) of the wetland plants and prevents carbon dioxide emissions which impact climate change. Special kind of ponds are formed by the beaver dams, which also provide excellent living conditions for fish (including protected species: weatherfish and bitterling), amphibians (like the European fire-bellied toad or great crested newt) and various water invertebrates. These ponds are also a great place for birds and forest creatures to drink from. Today, beavers in the Kampinos Forest perform an even more important function. Most of the watercourses here have unnatural, straight channels. By building dams, digging burrows, and felling trees into the water, beavers diversify the shape and character of the shoreline, initiating the formation of meanders and thus transforming artificially dug canals into more natural watercourses.

↑ Not many people know that beavers are able to sit on their own tails. (photo: Łukasz Łukasik)

BEAVER REINTRODUCTION

Beavers disappeared from the Kampinos Forest and from most Polish lands by the 19th century. The reason for this was land drainage and the hunting of this rodent valued for its nutritious meat and fur, which was used to make elegant men's hats, among other things. The return of the beaver to the Kampinos Forest occurred at the end of the 20th century, on April 26, 1980, when four females and three males caught earlier in the Suwałki Lake District were released in the Sieraków Strict Protection Area. This was part of a large beaver protection programme, under which a total of over 200 animals were resettled in various parts of Poland. These measures were a great success - nowadays beavers also thrive outside protected areas. However, new challenges emerge: on one hand, the activity of these rodents effectively helps to counteract the increasing frequency of droughts; on the other hand, their activity is often the cause of conflicts with landowners, as it can result in the flooding of fields, blocking road culverts and felling of valuable trees.

↑ The most well-known beaver dam in the Kampinos Forest, on the educational trail near Roztoka during the summer drought and in the pre-spring. The dams impound water only at low and medium flows. When there is a lot of water, it flows freely over the dams, which does not affect the water level. (photo: Michał Miazga)

Do Plants Like Water?

↑ Dead birch wood. Due to changes in moisture content, wetlands naturally undergo transformation from woodlands to open habitats, which over time become overgrown again. (photo: Katarzyna Fidler)

All plants need water, but the amount available in a given environment can determine which plants survive and which are outcompeted by better-adapted species. Long ago, before drainage activities in the Kampinos Forest, almost the entire area of wetland belts was covered by wetland vegetation: alder carr and riparian forests. Mostly alders and birches grew here, with occasional ash and willow. Open habitats, including sedges and reeds, were less numerous than today. They would form in the areas where water stagnated the longest or where vegetation was intensely grazed by wildlife.

Nature in the wetlands was in a state of dynamic balance. During wet years some of the trees died and the proportion of open ecosystems increased, while in dry years the expansion of trees and shrubs slowly transformed sedge meadows into wet forests.

Water not only determines the existence of vegetation but also shapes its character. In simple terms, oak-lime-hornbeam forests grow in fresh habitats (meaning adequately watered and aerated), and fresh meadow communities grow in agriculturally used areas. Wet and humid habitats include coniferous swamps, riparian forests, alder carrs, and on agriculturally used land, wet meadows and rushes. The abandonment of agricultural use of meadow communities usually triggers succession and, depending on the moisture content of the habitat, fresh meadows eventually turn into oak-lime-hornbeam forests and wet meadows into riparian forests.

↑ Fruit bearing hare's-tail cottongrass at the Długie Bagno marsh – a species growing in raised bogs and coniferous swamps, wet and acidic habitats. (photo: Agnieszka Gutkowska)

↑ Tall sedge rushes with purple loosestrife. Although loosestrife is a moisture-loving species, its presence in the reeds is a sign of summer dryness of this habitat. (photo: Agnieszka Gutkowska).

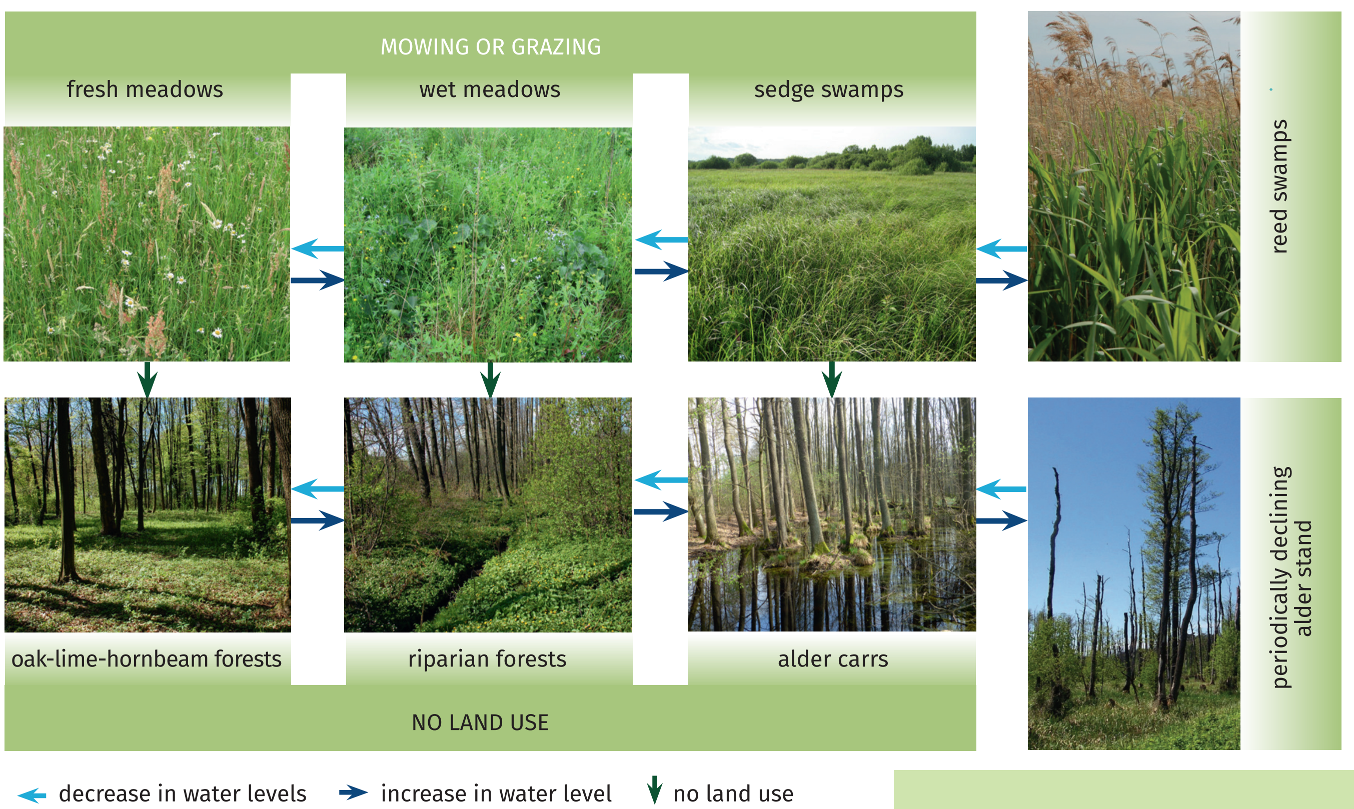
When more water becomes permanently present in a fresh habitat, more moisture-loving species will appear as a result. Over time, they will transform the habitat, for example from fresh meadows to wet meadows or from oak-lime-hornbeam forests into riparian forests or alder carr. A long period of stagnation of very high water in alder carrs can cause such forest stands to die and when this lasts for several years, only rushes may remain in the area. In drier years, on the other hand, alder carr can develop there again. Such fluctuations are common and represent natural cycles.

FERTILE AND POOR WETLANDS

Wetlands in the wetland belts in Kampinos Forest are very rich in nutrients. These are called fens. They owe their richness to the waters flowing through them. Large fluctuations in the water level facilitate the decomposition of plant remains, which also abundantly supplies these wetlands with nutrients. Reedbeds and tall sedges, some of which form tussocks, are characteristic of such wetlands.

The situation is different in wetlands located on dune belts, which are much rarer. They are mainly supplied by rainwater, poor in nutrients. Transitional and raised bogs have therefore developed there, with their characteristic vegetation, including low sedges and the well-known cottongrass. The best example of such a peatland in the Kampinos Forest is Długie Bagno [the Long Marsh] located near the cemetery in Palmiry.

Simplified diagram of plant population dynamics depending on moisture and agricultural use
(©Dorota Michalska-Hejduk)



How Dead Trees Bring Forests to Life

↑ The wet forests contain the largest amount of dead wood in the Kampinos Forest. (photo: Anna Andrzejewska)

↑ Deadwood logs play a key role in the naturalization of the forest's canals. (photo: Michal Miazga)

↑ Hermit beetle (Osmoderma eremita) (photo: Tomasz Hryniewicki)

A natural forest differs from a commercial one as the trees not only grow in it, but also slowly die and decompose making life possible for thousands of species, most of which cannot function without dead wood. For some species it becomes food, for others - shelter, a place to lay eggs or to overwinter, a hunting ground or a source of water on hot days. On the wetlands, dead trees are priceless as well. Tree seedlings develop on fallen tree trunks. They would otherwise not be able to germinate in the water that often covers the bottom of these forests. The fallen logs also provide paths among the wetlands for wolves or lynx. Small ponds emerge within the windthrows, which become excellent watering holes for animals. Fallen trunks and branches also play an important role in shaping stream channels. A tree toppled into a watercourse changes the direction of water flow and can cause scouring of the banks, which boosts microhabitat diversity. It is under fallen branches that fish like to take shelter, and it is on submerged logs that caddisflies (Trichoptera), snails and other invertebrates thrive, needing a stable surface to live on. Without the dead wood in the canals, there would be no such organisms in the Kampinos Forest.

Since the late 20th century, as wetland conditions in the Kampinos Forest have gradually improved, large numbers of trees—mainly birch, alder, and occasionally pine—have died in various areas. This is an entirely natural process. Indeed, the improvement of wetland moisture levels leads to the growth of open habitats. In today's Kampinos Forest, the amount of dead wood is steadily increasing. It is most abundant in the riparian forests of Kampinos – almost 40 m3/ha, while on average in the entire Park they account for 23 m3/ha. This is over four times more compared to an average commercial forest. However, old-growth forests need considerably more dead trees. It is estimated that in natural forests there may even be more than 200 m3/ha of them.

↑ Scarlet elfcup (Sarcoscyphaceae), one of over a thousand fungi populating dead trees (photo: Katarzyna Fidler)

↑ Fallen snag in Żurawiowe protection area. Tree seedlings, even those thriving in wetlands, cannot germinate under water, therefore a new generation of trees often grows on the decaying trunks of fallen trees. (photo: Michal Miazga)

LIFE ON DEAD TREES

Scientific studies show that far more organisms live in dead wood than in living. Up to 1,500 species of fungi and lichens, 1,300 species of invertebrates and more than 100 species of vertebrates can be found on dead wood. It is home to vascular plants, mosses, algae and slime mold.

The rotting wood is inhabited by thousands of species of invertebrates: snails, arachnids, myriapods, Hymenoptera, ants and other interesting creatures. Protected beetles such as the hermit beetle (Osmoderma eremita) or flat bark beetle (Cucujus cinnaberinus) seek refuge and food here. Vertebrates also benefit from dead trunks and branches: amphibians, reptiles, birds, mammals, and even fish when the wood is submerged in water. The same goes for sand lizards (Lacerta agilis), common lizards (Zootoca vivipara), grass snakes (Natrix), shrews (Sorex), water shrews (Neomys fodiens), and even big mammals such as foxes, badgers or lynxes. Woodpeckers forge hollows in decaying trunks, which can later play host to tits, hoopoes (Upupa epops), flycatchers (Muscicapa) and treecreepers (Certhiidae).

The world of fungi is very rich with thousands of species, including such rarities as varnished conk (Ganoderma lucidum), scarlet elfcup (Sarcoscyphaceae), hen-of-the-woods (Grifola), beefsteak fungus (Fistulina hepatica), Artomyces and many others. Among the forest vascular plants, we will find ferns, ground ivy (Glechoma hederacea) or delicate wood sorrels (Oxalis acetosella) thriving on dead wood.

← A lynx in the Kampinos Forest. After over 200 years of absence, these animals were reintroduced to Kampinos. Lynxes prefer forests with large amounts of dead wood. It enables them to move stealthily and hunt from ambush, which is typical for this species. (photo: Kampinos National Park Archive)

MAN IN THE WETLANDS

The History of Draining the Kampinos Forest

↑ Confluence of the Zaborowski and Łasica canals (photo: Anna Andrzejewska)

DESCRIPTION OF THE KAMPINOS WETLANDS BY KING STANISŁAW AUGUST PONIATOWSKI'S COURT CARTOGRAPHER

“There are swamps in Kampinos Forest – one is called Pożar ¼ mile from Kampinos, ½ mile long to the east, and ¼ mile wide. The second one called Bieliny is nearby in that forest to the west, a small mile from the church, almost ½ mile wide and longer than one mile. Both these swamps dry out in summer. After Kampinos to the north, going through the forest to Górki village, there are four fords. Turning to the east just near Górki on the road to Nowa Wieś, there is also a ford 30 steps long, the same when going next to Górki to the west to Cisowe village, there is a ford as well. Almost all the fords dry out in summer”.

Until about 300 years ago, the greater part of the Kampinos Forest was an area of wetlands overgrown mostly with damp forests, from which irregular mineral islands emerged. The first sign of forest settlements located inside the Kampinos Forest dates to the beginning of the 18th century. At that time, it was inhabited by "people of the forest" – budnicy [similar to ‘colliers’], who cut trees and burned charcoal or tar. They would grub up trees and create small plots to plant basic cereals and keep animals. Their settlements consisted often of loosely scattered miserable huts or dugouts recessed into the earth. During summers the wetlands dried out making life a bit easier for inhabitants, while in spring and fall the terrain was very damp and difficult to get through with dry feet.

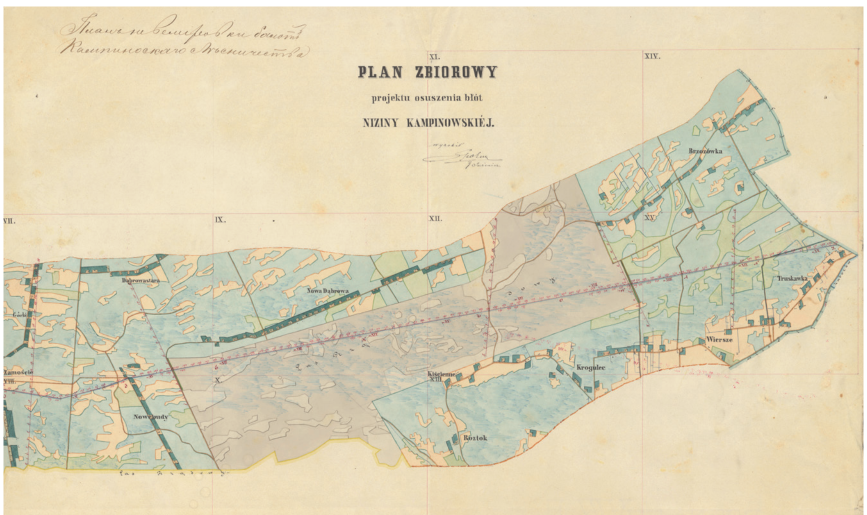
A major shift in thinking about the future of the Kampinos Forest occurred during the Prussian partition (1795–1806). The area was subjected to the Enlightenment idea of amelioration (from Latin melioratio), which meant the subordination of nature to man and his goals. At that time, the first plans were made to drain the local wetlands. However, the Napoleonic era and the subsequent turmoil of war meant that plans for the land drainage of Kampinos were discontinued. This idea returned in the 1840s, and the first section of the Łasica Canal, from the Bzura River upstream to Janówek village, was probably dug between 1870 and 1880.

Drainage projects and the construction of a canal system continued up until the 1970s, which is when the Kampinos National Park was already in existence. First, the Łasica Canal and the Zaborowski Canal were built, and during the Second World War the Olszowiecki Canal was completed.

In the 1960s, the Kromnowski Canal was dug, as well as a network of detailed ditches. It was not until the 1970s that the Ł9 Canal was built as the last one, and at the same time the Łasica Canal was extended as far as to Adamówek village, to connect it with the Wilcza Struga. At that time, the beds of the Łasica and other canals were cleaned and unblocked again. Flood embankments along the Vistula and the Bzura rivers were successively built and completed in the 1970s, which finally cut off the area of the Kampinos Forest from the influence of the flood waters that once fed the Kampinos wetlands. What remained of the natural sections of the watercourses were, for example, sections of the Struga flowing into the Zaborowski Canal or Wilcza Struga connecting with Łasica.
The network of canals completely transformed the area's water relations. Instead of stagnating in the wetlands and irrigating them, water from the spring floodplains quickly drains into Łasica Canal and leaves the forest. In the summer, on the other hand, there is so little water that the wetlands often dry up almost completely and the meadows yield less hay due to the lack of water.

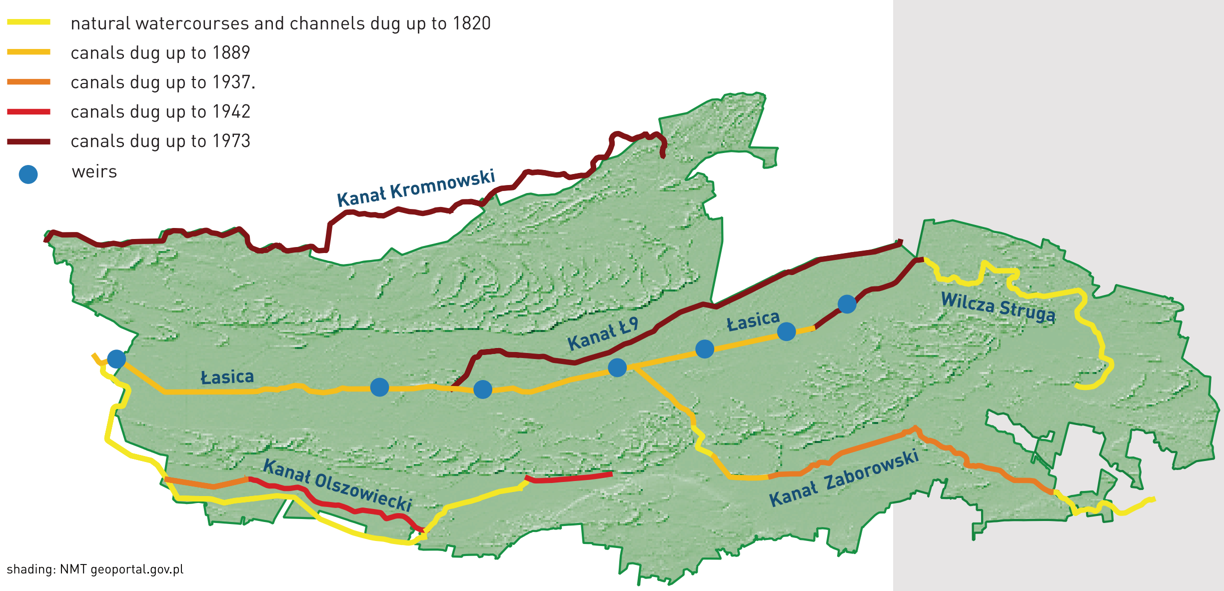
↑ Yellow waterlilies (Nuphar lutea) in Łasica. Plant communities familiar to lakes often appear here because of the absence of water flow during the summer in Kampinos' canals. (photo: Michał Miazga)

↑ Ł9 Canal in Górki. The last of the big canals in Kampinos dug out at the beginning of the 1970s. (photo: Michał Miazga)



← "The Project of Draining Swamps of the Kampinos Lowland" from 1861. Besides the planned course of the Łasica, the map shows the layout of villages at the time with their gardens (dark blue), cultivated fields (light brown), wetlands (light blue) and forests (green). The grey polygon in the centre of the map represents the Government Forests. (The Central Archives of Historical Records in Warsaw via Tomasz Związek)

Development of the network of canals in the Kampinos Forest
(©Michał Miazga)



shading: NMT geoportal.gov.pl

Life after Drainage

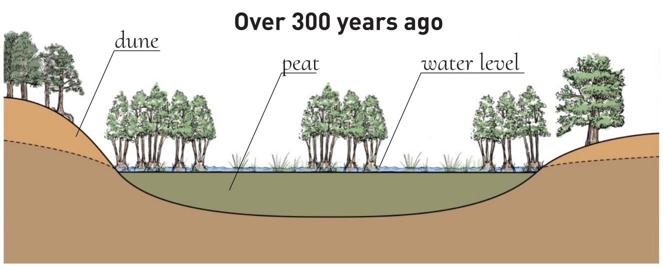
↑ Private plots of land near Łosia Wólka. Most of the private land in Kampinos is not currently farmed. One of the reasons for this is the deteriorating quality of drying peatlands. (source: Archiwum KPN)

↑ Due to varying moisture content conditions, peat decomposes - it becomes mucky, losing its spongy structure and the ability to retain water. (photo: Anna Andrzejewska)

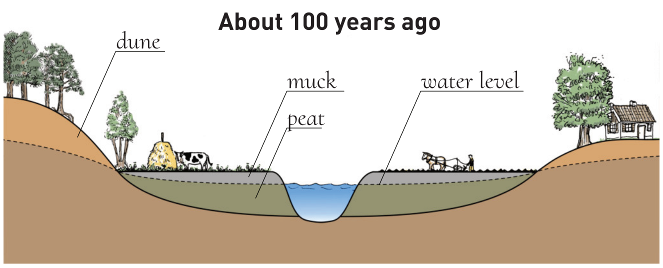
↓ Changes in swamp depressions and the impact of land drainage on peatlands (©Anna Andrzejewska, Andrzej Pachowski, Joanna Pachowska)

Draining projects and land use changes in the Kampinos Forest have had serious consequences for the water cycle and the local wildlife. In the past, water tended to stagnate in the wetlands and only in the spring, during periods when water levels were high, drained away from the surface of the wetlands. The advent of canals and ditches allowed water to run off quickly and caused the land to dry out considerably. The groundwater level dropped by up to 1.5m and became less stable. An unfortunate effect of the lowering of the groundwater level was the inhibition of peat-forming processes. For this reason, there are currently no larger areas of living, growing peatlands in Kampinos. These changes and the emergence of agriculture were not without impact on the vegetation. Meadows and, in places, even arable fields began to dominate the landscape. The area of wetlands, in particular swamp forests, drastically decreased.

Unfortunately, over time, the intensification of agricultural production has had a negative impact on soil condition. On contact with the air, the peat lost its original spongy structure, settled, mucked up, and in times of drought the wind blew it away from fields and roads in the form of black dust. To make matters worse, when the mucky peat dried out, it struggled to absorb water, exacerbating the problem of local flooding. It is estimated that in peatland areas the ground surface lowered by up to 1 m due to mucking.



Originally land depressions were filled with peat and covered with swamp forests and rushes.



After the canals were dug, the water level decreased. The top layer of peat was drained, allowing meadows, pastures and fields to appear.

This lowering of the ground level caused secondary flooding and the marshing of lower lying areas. These processes, together with the spread of modern farming methods and artificial fertilisers, have caused major changes in the species composition of the Kampinos meadows and impoverishment of wildlife. With time, as the degradation of the soil worsened, the agricultural usefulness of these areas also declined.

However, when writing about these negative effects of drainage activities, it is important to remember that at the time they were carried out, there was a huge hunger for land. Efforts were made to make every scrap of land productive to feed the rapidly growing population. Such activities were undertaken not only in Kampinos, but also on a massive scale in other parts of Poland and Europe. Only with the passage of time did it become apparent that not all of these activities were appropriate, even though they were in line with the knowledge and needs of the era. Indeed, for a while the Kampinos wetlands provided satisfactory crops for the local inhabitants. As the soils started to deplete and deteriorate, farming in these areas ceased to be economically viable. In addition, times changed, and with them the possibilities and aspirations of the forest residents. Most of them abandoned farming, sold their land and moved outside the forest. Those who remained gradually started to abandon land cultivation. This offered an opportunity to restore the natural water cycle in the Kampinos wetlands, in line with modern human needs and for the benefit of wildlife. Activities of this kind are being undertaken not only in the Kampinos National Park, but also elsewhere in Poland and Europe.

DRAINING THE WETLANDS AND CLIMATE CHANGE

Wetlands with high and stable water levels absorb carbon dioxide and are excellent carbon sinks, counteracting climate warming. The parts of plants that wither under anaerobic conditions do not fully decompose and accumulate to form expanding layers of peat.

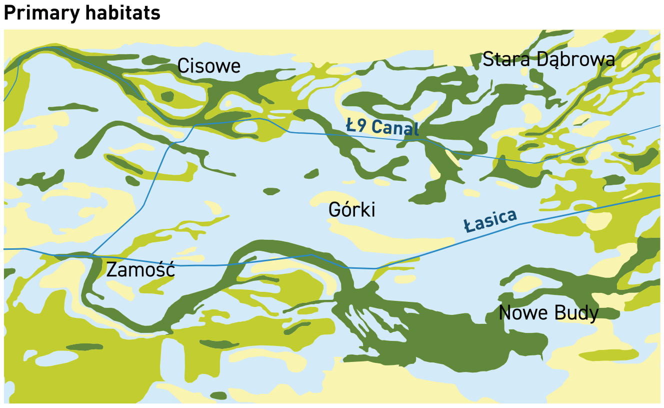
The draining of wetlands releases the carbon stored in them into the atmosphere. They thus become significant emitters of carbon dioxide, as well as methane and nitrogen oxides. It is estimated that annual emissions from drained hay meadows reach around 20-30 tonnes of carbon dioxide equivalent per hectare, which is comparable to the emissions produced by circling the earth six times in a passenger car.

Greenhouse gas emissions from drained wetlands can be easily curbed by re-wetting the wetlands. As soon as adequate water levels are reached, carbon dioxide emissions are reduced to almost zero.

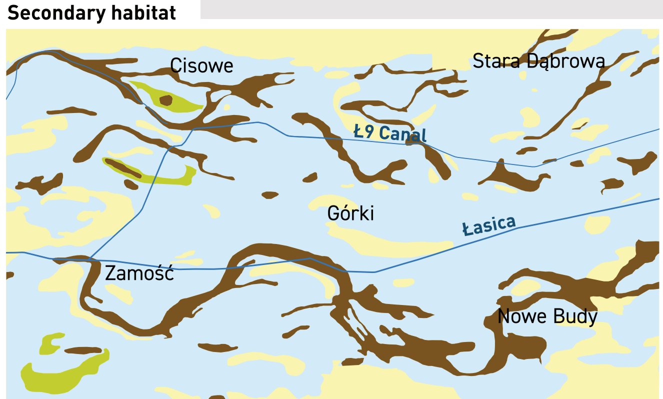
The effects of drainage practices and the lowering of water levels on wetland habitats of the Kampinos Forest. Due to drainage peat decomposed in the area with a disrupted peat formation process.

(©Karolina Bukowicka based on: Tomasz Okruszko, Waldemar Mioduszewski, Leszek Kucharski, Ochrona i renaturyzacja mokradeł KPN [Protection and restoration of the Kampinos National Park wetlands], SGGW Publishing, Warsaw 2011)

Primary habitats

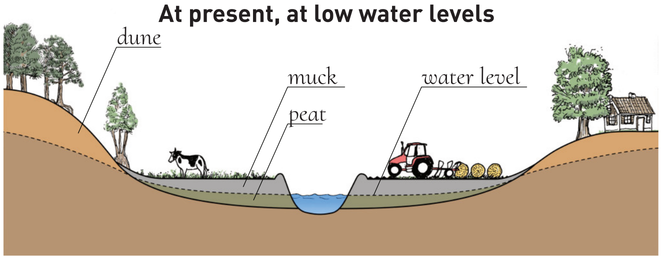


Secondary habitat



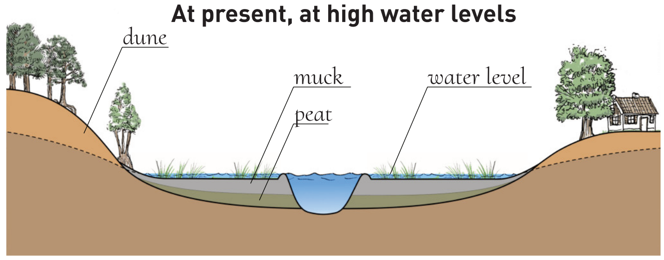
peatland · muckland · soil-forming habitats with significant fluctuations in water levels · soil-forming habitats with periodically high levels of water · non-water habitat

At present, at low water levels



The dried peat settled and disappeared. The ground level lowered and the water level also decreased.

At present, at high water levels



Currently, during periods when there is more water, it floods the land depressions.

Attempts to Decrease the Runoff of Kampinos Waters

↑ Weirs in Nowa Dąbrowa (centre of the Kampinos Forest) and in Sianno (west of the forest). The former, thanks to the renovation recently carried out by PGW Wody Polskie [National Water Management Authority], is the only well-performing weir in the Forest. The latter, due to its leakage and late closure after winter, is unable to hold water during dry periods. (photo: Michał Miazga, Anna Andrzejewska)

The drainage system built in the Kampinos Forest was intended to evacuate excess water. Rapid outflow caused excessive over-drying of the land, hindering its agricultural use. To counteract this, the canals were equipped with a system of impounding structures – sluice gates and weirs. Currently, there are seven weirs on the Łasica Canal alone within the boundaries of Kampinos National Park. Unfortunately, this system has not been properly working for many years. The deteriorating technical condition of the weirs, their inappropriate usage, and the unauthorised raising of gates has resulted in these structures having only a minimal impact on the water level in the Kampinos Forest. On other watercourses, several weirs and regulated sluice gates were constructed. These were intended to help control groundwater levels. Nowadays, these sluice gates usually no longer impound water. However, where weirs with a fixed impoundment height have been built, the devices still perform their function.

With the discontinuation of agriculture and the progressive repurchase of land by the Kampinos National Park at the beginning of the present century, it became possible to take action to restore natural water relations in selected parts of the forest. The Park staff erected structures on smaller ditches. They were made from natural materials obtained in the vicinity. Mainly, weirs or thresholds were erected from oak or black acacia stakes and filled with branches and soil. This solution is very cheap and easy to make. Some of these structures have been functional for many years, but unfortunately in many places they have proved to be unsustainable and have been washed away by higher waters.

The next stage of wetland restoration was the 'Kampinos Wetlands' project carried out between 2013 and 2019. Several dozen valves, weirs and fords were then constructed on smaller drainage ditches on land belonging to the Park.

↑ A levee in Sadowa village, reconstructed under the „Kampinos Wetlands" project, separating the wetlands from the built-up area. (photo: Michał Miazga)

Each of these structures impounds water locally, to a maximum height of 30-40 cm. Where the canals cut through natural depressions, water has been diverted into the beds of braided depressions formed by former natural water flows. Levees have also been formed to retain water in the meadows before it flows into the Łasica Canal. Additionally, the levee in the village of Sadowa in the Łomianki municipality has been reinforced, so that during floods the water from the forest does not overflow into built-up areas. The construction works were preceded by thorough analyses, and the implementation itself was commissioned to specialised companies. As a result, permanent and maintenance-free structures were built that do not pose a threat to private land.

UNIMPLEMENTED IDEA OF IRRIGATING THE KAMPINOS FOREST

As early as before the Second World War, it was noted that because of the digging of a deep channel of the Łasica Canal and the Olszowiec Canal, the soils became so dry that it had a detrimental impact on agriculture. To counteract this, a project was drawn up in 1938 to supply the drainage system of the Kampinos Forest with water from the Vistula. The construction of a pumping station near Dziekanowskie Lake was even planned, which was to pump water from the Vistula into the Kampinos Forest. The outbreak of war thwarted these plans. In the 1960s the idea was revived, and various options were considered, but again failed to materialise.

← One of the fords built in 2018 as part of the 'Kampinos Wetlands' project. Fords impound water and, at the same time, allow field and rescue services to pass through. (photo: Michał Miazga)

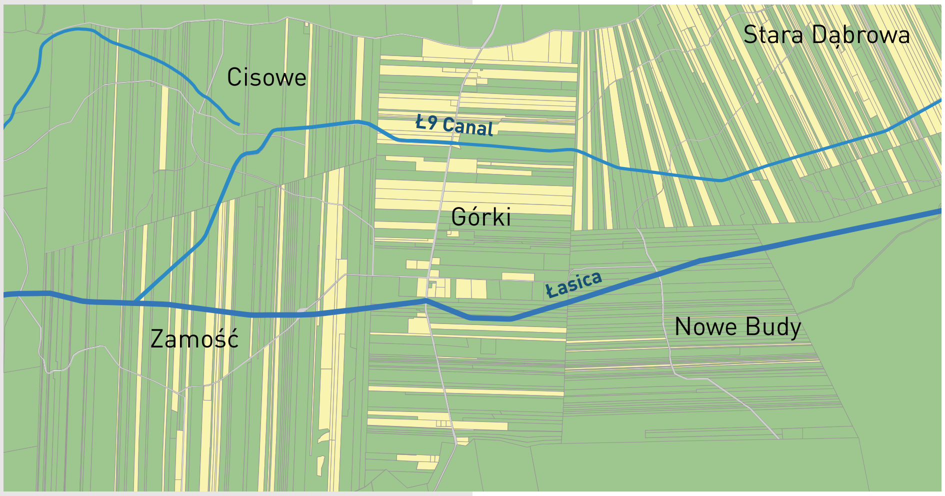
↑ A barrier on the Wilcza Struga built in 2009 as part of the Small Retention Programme, immediately after construction and at present. Despite the passage of years, the barrier still slightly impounds the water. (photo: Piotr Stefaniak, Anna Andrzejewska)

Buyouts for Nature

↑ Spring floodplains in the meadows near Brzozówka village. Following the purchase of the land by the Park, such flooding is no longer a problem. (photo: Michał Miazga)

The Kampinos National Park was established in 1959. Its boundaries included both state-owned lands, previously owned by the State Forests, located mainly on dunes, and private land situated mainly on wetland belts. A key decision for the future of the Kampinos Forest was taken in 1975 and concerned the buyout of private land for the purposes of nature conservation. At that time, an area of over 14,000 ha (which accounted for nearly 40% of the Park) including 67 villages with roughly 16,500 inhabitants, was scheduled for buyout. The buyouts began in 1976 and immediately gained momentum. Over 6,000 ha were purchased in the first five years. Due to lack of sufficient funding in subsequent decades the pace of buyouts slowed considerably and remained at an average of around 120 ha per year. Nevertheless, it has been possible to continue this endeavour up to the present day.

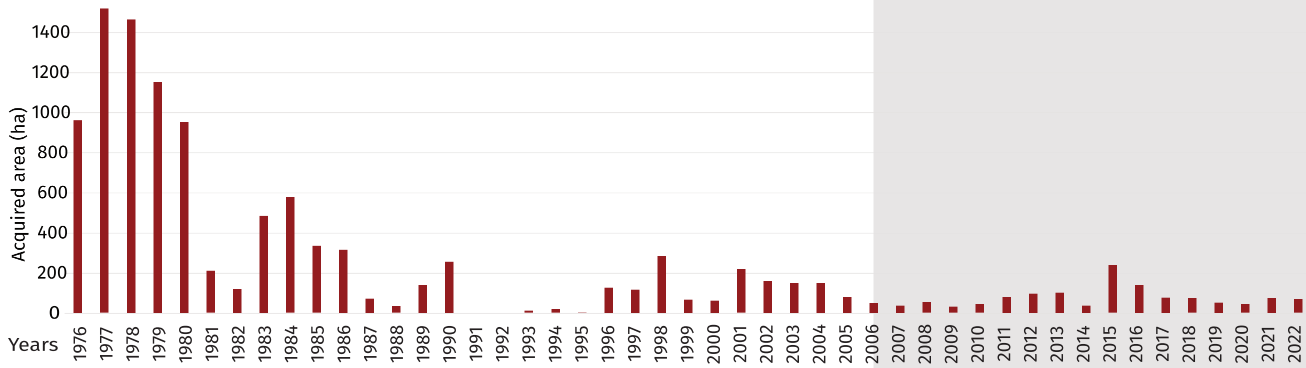
The Kampinos National Park buys properties on an entirely voluntary basis, according to the order of submissions. Currently, in mid-2024, the list of land submitted for sale by owners covers nearly 500 ha. The maximum sale price is determined by an appraiser, who assesses the value of the property in question by comparing it with other transactions in the given municipality.



'Chequered' land ownership in the center of Kampios Forest
(©Karolina Bukowicka based on the Kampinos National Park data)

ownership of plots of land
in the ownership of the Kampinos National Park
private

Buyout area in subsequent years
(©Paweł Dzirba)



The Park also acquires a lot of land thanks to pre-emption rights. This means that the Park can take over a sale transaction of a property within its boundaries and purchase it at the price originally agreed between buyer and seller. Usually, the Park exercises this right if the price does not significantly exceed the market price. If the price is abnormally high, the Park may ask the court to determine the actual value of the property.

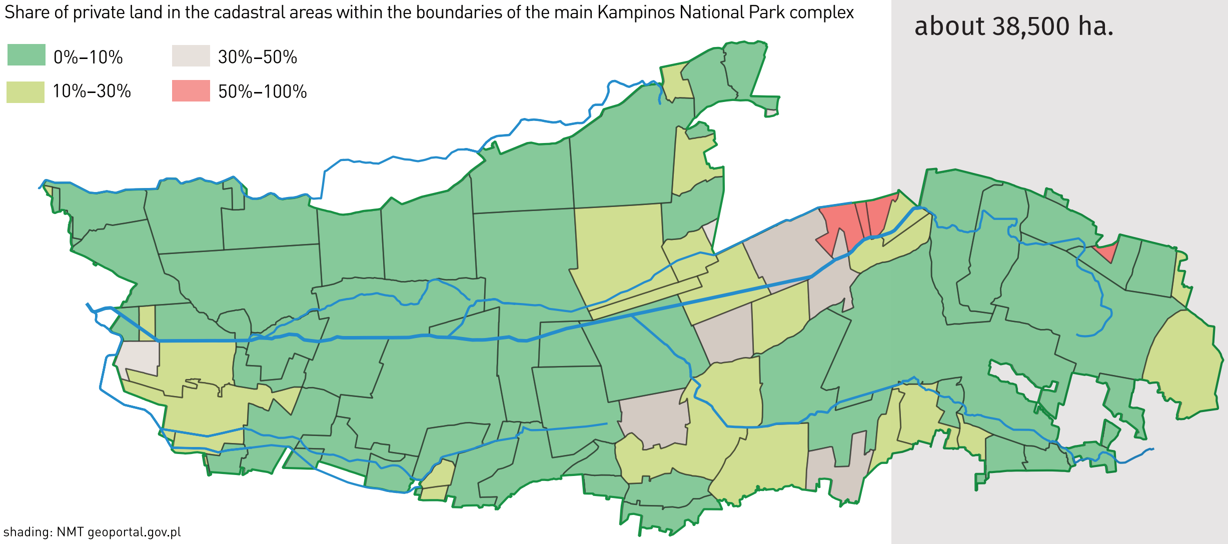
The Park also uses various types of financial support instruments, either national or EU, under which it acquires selected properties with the purpose to protect specific habitats and species.

Currently, the land area of the Kampinos National Park (under the ownership of the Park and of the State Treasury in perpetual usufruct of the Park) amounts to about 34,000 hectares and accounts for circa 97% of the total area of the Park.

Due to the voluntary basis of the buyout in some areas of the Park the land looks similar to a chequerboard. Long and narrow private plots are adjacent to plots belonging to the Park, which are often forested or left to natural succession. This hinders both agricultural activities and nature conservation, becoming a source of potential conflict. Wetland conservation activities can only take place in areas where the Park owns 100% of the land.

Share of private land in individual villages in Kampinos National Park
(©Anna Andrzejewska)

Share of private land in the cadastral areas within the boundaries of the main Kampinos National Park complex



shading: NMT geoportal.gov.pl

CHANGES IN THE SIZE OF THE KAMPINOS NATIONAL PARK

At the time of establishment of the National Park, its area was over 40,000 ha. In 1975, together with the decision to start the buyouts, it was resolved to exclude about 5000 ha of land valuable for agriculture in the municipality of Czosnów, including the plots in the villages of Sowia Wola, Brzozówka, Aleksandrów and Cybulice. In 1997, another change to the Park's boundaries ensued - it was enlarged primarily to include areas in the Brochów municipality - the village of Brochów Łąki and in the Czosnów municipality - the villages of Aleksandrów and Brzozówka, as well as other smaller plots. These areas were intended to protect the features of the traditional landscape of the Mazovian countryside. Since then, the area of the Park covers about 38,500 ha.

The Impact of Climate on Nature in Kampinos

↑ A canal near Truskaw in 2023. Even a beaver dam did not help it retain water. In the future, such situations may occur more often. (photo: Michał Miazga)

↑ With the warming of the climate, praying mantises (Mantis religiosa) have arrived from the south. (photo: Karol Kram)

Since at least the 1950s, a warming climate has been recorded across the globe. This is caused by human-induced emissions of greenhouse gases such as CO2 and methane. These gases act in the atmosphere like glass in a window. They let in direct sunlight and stop reflected heat radiation from the ground. Compared to the pre-industrial era, the concentration of GHG in the atmosphere has doubled. The Earth's climate has always changed, but (compared to the human lifespan) very slowly. For the last 10,000 years the climate has been stable and life on Earth, including humans, has adapted to it. However, since the beginning of the industrial era, air temperature has begun to rise rapidly. On average, over the last 70 years or so, global temperature has risen by almost 1.5ºC. This increase is not uniform. Some areas are warming faster, others slower: land heats faster than oceans, circumpolar areas faster than equatorial areas.

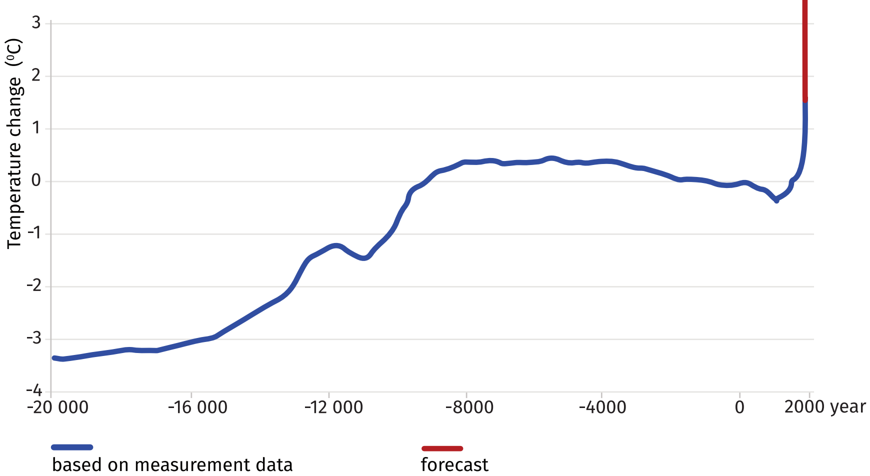
Meteorological measurements have been conducted in the Kampinos Forest since the 1990s. It appears that the average annual air temperature has risen by around 1.5ºC in the last 30 years alone. The fastest warming occurs in winter - we see snow falling less often and melting faster. Average air temperatures rise at a slower pace during summer. The change in temperature also affects the amount and distribution of precipitation throughout the year.

Forecasts indicate that this situation will become increasingly unfavourable both for nature and agriculture. The overall amount of precipitation is growing slightly, but this increase is recorded mainly in winter. In future, there will be less summer precipitation, and it will be cumulated in the form of torrential rains, with increasingly longer periods without precipitation in between.

The higher the air temperature, the greater the evaporation and transpiration of water by plants. With low (or no) rainfall, droughts become more severe and prolonged. Heavy rains falling on dry soil do not soak in but quickly run off into watercourses and are discharged down the catchment area. This leads to flash floods. The only way to reduce the effects of droughts and floods is to retain water where it has fallen and keep it there for as long as possible. Wetlands are particularly suited for this purpose.

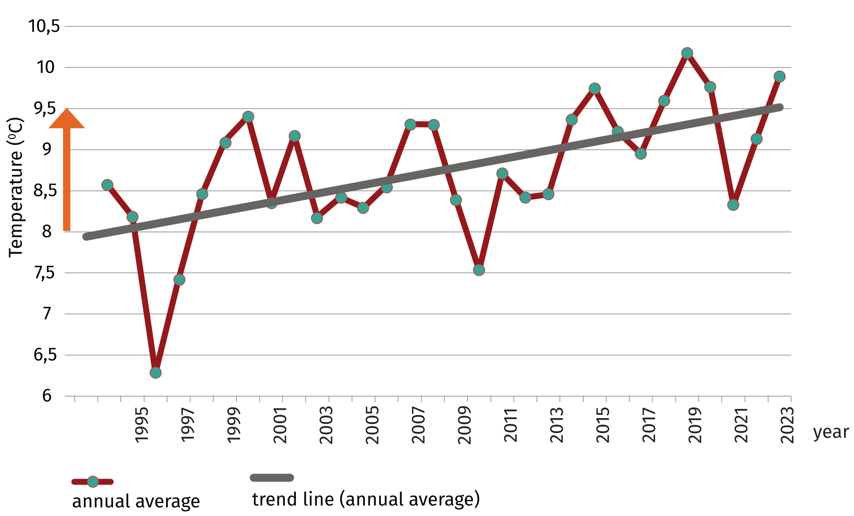
Temperature changes over 22,000 years - since the maximum of the last glaciation. The temperature is presented as a deviation from the average over the period 1961-1990. At the time of the glaciation maximum, the Earth's average temperature was only about 3.5ºC lower. Since the 1950s, it began to rise rapidly

(source: Marcin Popkiewicz, Aleksandra Kardaś, Szymon Malinowski, Nauka o klimacie [Climate science], Sonia Draga Publishing House and GAB Media, Katowice 2019)



Average annual air temperature in Granica in the Kampinos Forest. The straight line illustrates the general trend of change, indicating that over the 30 years of measurements the average annual temperature has increased by 1.5ºC.

(©Anna Andrzejewska)



HOW DOES CLIMATE CHANGE IMPACT NATURE?

We are witnessing changes in the distribution of plant and animal species. Formerly rare species from southern Europe are appearing in our country, while those previously common in Poland are receding, showing signs of weakness, increased susceptibility to pathogens and disease. The examples are numerous: the wasp spider (Argiope bruennichi) and the praying mantis (Mantis religiosa) - once great rarities and protected species, are now common not only in the Kampinos Forest, but even in the Suwałki region. Meanwhile, the pine trees, which make up about 70% of the trees in the Kampinos Forest, are weakened, lose their needles earlier and are covered with mistletoe. In drier years, some trees are attacked by the sharp-toothed bark beetle (Ips acuminatus), followed by fatal fungal pathogens. It is simply too warm for them. Cranes, on the other hand, which used to fly away for the winter, now often overwinter in Poland, also in the Kampinos National Park.

↑ Wasp spider (Argiope bruennichi). As recently as 30 years ago, it could only be found in southern Poland on warm sites; in the Kampinos Forest it was a rarity. Nowadays, it is widespread throughout the country. (photo: Anna Andrzejewska)

Non-obvious Links

↑ Such irrigation systems currently support agriculture near Kampinos. They use the groundwater resources that also serve the Kampinos Forest.
(photo: Gleaminvisible/Shutterstock.com)

There are many human activities which impact the wetlands, though they seem to have nothing to do with them. Some of these activities have been known to the wetlands' inhabitants for centuries, others were discovered by science only recently. Dutch settlers in the 18th and 19th centuries planted trees around their houses and on the balks to lower the groundwater level. Trees consume large quantities of water and thus drain the area, an effect of which few people today are aware.

Much has changed in the Kampinos Forest with the erection of Vistula embankments. Until the 19th century, during floods water poured at times into the Kampinos Forest and only belts of dunes protruded above the surface of the floodplain. The last great flood on the Vistula occurred in 1947. A report on it, entitled 'Powódź – 1947' [Flood – 1947], can be watched on YouTube. When the embankments were completed shortly afterwards, in the 1960s, Kampinos was finally cut off from the Vistula and today the water level in the river has no significant impact on the Kampinos wetlands.

However, there is a strong impact related to urbanization. The transformation of fields and forests into buildings and roads lead to the change in the natural water cycle between Kampinos and its surroundings. Water from rainfall, instead of soaking into the ground and seeping underground into the Kampinos marshes, runs quickly down roofs, paved driveways, pavements and streets into the surrounding ditches and streams that feed the forest.

↑ Vistula embankments protect people against floods, but also cut the Kampinos Forest off from the Vistula River, breaking a relationship which lasted for over 10,000 years. (photo: Adam Olszewski)

As a result, the amount of water in the wetlands increases rapidly during the rains but then decreases just as rapidly as the wetlands are less and less fed by groundwater from around the forest, especially from the Łowicz-Błonie Plain.

The water level is also decreasing due to groundwater intakes. The largest intake in the vicinity of Kampinos is in Wólka Smolana. It supplies water to Sochaczew and Brochów, and the extent of its depression funnel is estimated at 10 km2. Increased water intake is also taking place on the Łowicz-Błonie Plain, where agricultural crops are irrigated with increasing intensity, often using huge mobile systems. This depletes the water supply that feeds the wetlands of the Kampinos Forest. More and more often, owners of wells are forced to deepen them.

There are many surprising effects of raising the ground level for construction purposes. Some of the land around the Forest is damp. To build houses in such places, the owners - sometimes in violation of local regulations - raise the ground level by dumping soil. Water is therefore pushed out of this once waterlogged area, and the directions of groundwater and surface water flow change. This results in flooding of land located both in the Park and its vicinity, which had not previously flooded, as well as occasional flooding of buildings located next to the raised plots.

Occasionally there is a lot of confusion about how to understand the effects of damming on water levels in watercourses. There are opinions that Non-obvious Links damming raises the water level along the entire length of the watercourse above thedam. Hence some residents believe that the cause of flooding in the municipality of Czosnów, in the eastern part of the Park, may be the impoundment at Sianno weir located on the Łasica Canal more than 20 km away, at the western end of the Park. Meanwhile, each impounding structure has its own specific impact range, which is calculated by engineers at the planning stage of a particular project. For example, weirs on the Łasica Canal were built at 2-4 km from each other, as this is the maximum impact of this type of impounding structure.

THE KAMPINOS FOREST IN ISOLATION

Over the past few decades, the surroundings of the Kampinos Forest have been rapidly urbanised. This threatens to interrupt animal migration routes and isolate the forest's populations. To protect Kampinos from this effect, a number of ecological corridors were planned. Unfortunately, they function ever poorly. For example, two ecological corridors linking the forest with the Vistula valley have been designated along a stretch of over 20 km between Warsaw and Kazuń Polski. In some places their width is only 100 m. Unfortunately, buildings are already appearing in these corridors, and in addition they are crossed by a national road and other smaller roads. The newly constructed S7 road has only one passage for large animals planned on one of the corridors.

↑ A moose near Borzęcin village.
Wildlife corridors are essential for animals to move between the Kampinos Forest and neighbouring undeveloped areas.
(photo: Anna Andrzejewska)

↑ The terrain between the Vistula and Kampinos near Łomianki. The view from 1934 and today. A small village transformed into a town, which resulted in cutting off the forest from the Vistula in this area.
Similar changes are taking place in many areas bordering the Kampinos Forest. (source: geoportal.gov.pl)

KAMPINOS WETLIFE PROJECT

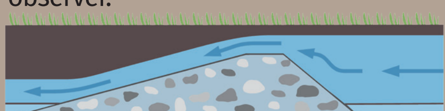
Water for the Wetlands

A riffle on the River Gowienica near Szczecin. Similar riffles will be installed in the Kampinos Forest. (photo: Michał Miazga) →

RIFFLES

These are stone and gravel prisms, unconsolidated, formed in such a way as to achieve an appropriate impoundment level, flow velocity and passage for fish and other creatures. The slope of the riffle, along which the water flows, is formed very gently and for an impoundment level of 1 m may be as long as 20 m. Such slope is reinforced with larger boulders, which further disrupt the water flow, increasing its oxygenation and making it easier for fish to cross the riffle.

Riffles being built in the canals of the Kampinos Forest will impound no more than one metre of water. Several dozen tonnes of aggregate will be used to construct each one of them. As examples from other parts of Poland show, after a few years the riffles will blend in with the landscape and, already at mid-water level, will become almost invisible to an outside observer.



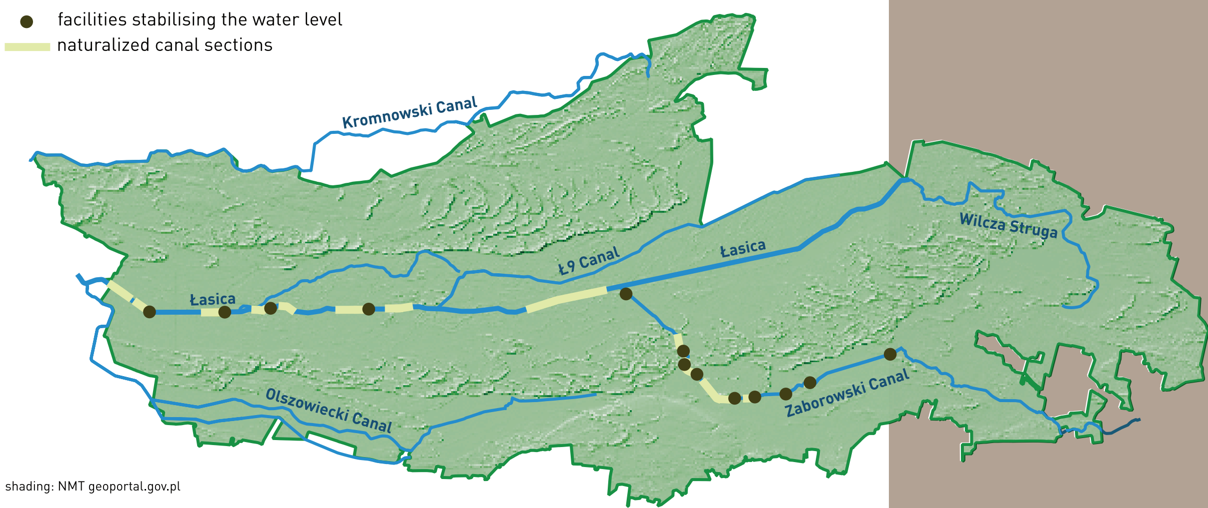
Cross-section of a riffle

The most important goal of the Kampinos WetLife project is to improve the condition of the wetlands by increasing their hydration. This essentially means extending the duration of spring flooding and stabilising water levels in the wetland.

There are plans to build 13 impounding structures on the Zaborowski Canal and the Łasica Canal and a dozen or so smaller structures on minor ditches, mainly around meadows in Kępiaste, which are being purchased as part of the project, as well as on the Kacapski Canal. Most of the barriers will be in the form of rock/gravel riffles, in isolated cases wooden weirs will be constructed (Debły area) and a sluice gate on an existing culvert (Zaborów Leśny).

The number and locations of the damming structures were carefully considered. Hydraulic modelling, i.e. computer simulation of the water flow, was carried out for this purpose, considering the terrain, vegetation, meteorological conditions and a great many other factors. A total of 38 scenarios were tested to analyse the current water cycle and three, successively refined versions of the planned impoundments. It was tested how the water in the Kampinos Forest would behave after the implementation of the impounding structures, if the rainfall of 2010 was repeated (wet year), 2009 (dry year) and 2008 (average year). Simulations were also carried out for the characteristic water levels used in the design of water facilities: high, medium and low, and for the maximum flows occurring once every two years, once every 100 years and once every 200 years

Location of planned impoundments and naturalised canal sections (see p. 28). The gradient on the Łasica Canal is almost twice as low as on the Zaborowski Canal, hence the impounding structures can be placed there at greater distances.
(©Karol Kaszyński)

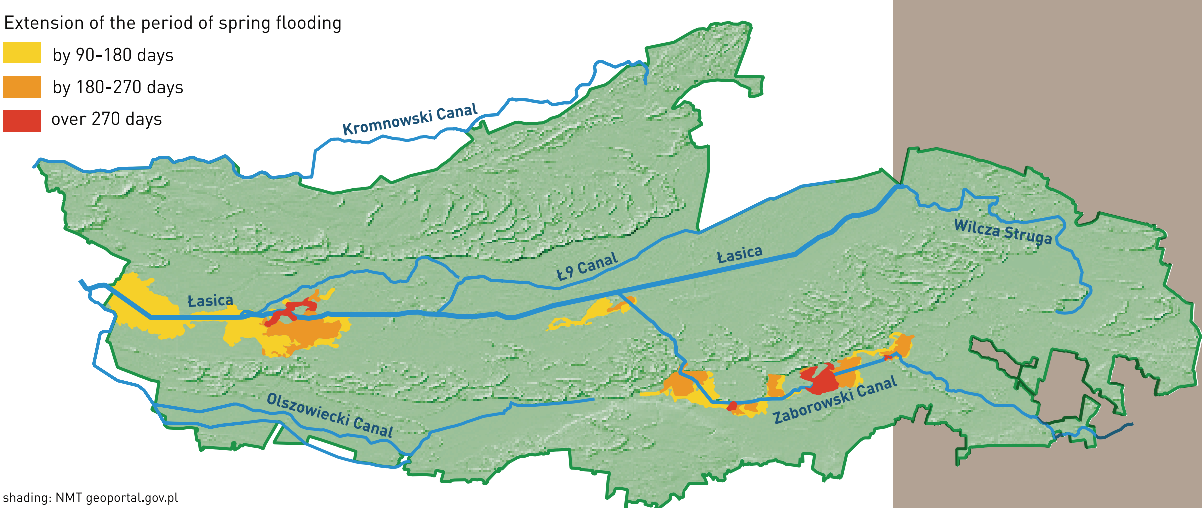


(these variants are tested in flood control analyses). Each time, the current situation was compared with that after the construction of the planned impounding structures. This broad selection of scenarios made it possible not only to check the impact of the planned structures on nature, but above all to assess the level of flood safety of the proposed technical solutions.

As expected, the modelling confirmed that the planned impounding structures will have the strongest impact on medium and low waters. In the case of high waters, where the waters already flow the entire width of the valley, the impact of the planned measures will be relatively the smallest. Modelling has demonstrated that the most important effect of the planned activities will be the extension, by more than three months, for water to stagnate in large areas of the Kampinos Forest. It is worth noting that these are, for the most part, lands already owned by the State Treasury or in the process of being bought out.

↑ Extending the duration of spring flooding is the most important objective of building impounding structures on canals in the Kampinos Forest. (photo: Michal Miazga)

Extension of the period of spring flooding after project implementation (modelling results for a year with average precipitation).
(©Karol Kaszyński based on hydraulic modelling results)



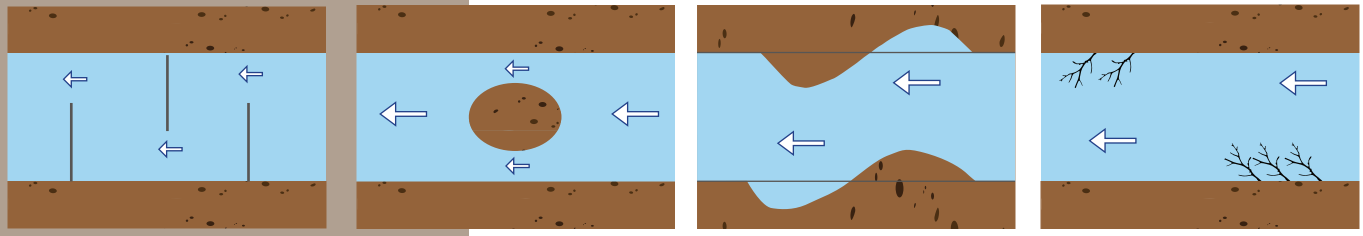
Naturalisation of Canals

↑ A unique section of the Łasica, which at low water is already beginning to resemble a natural stream. In open areas, aquatic and reed vegetation plays the most important role in the naturalization of canals.
(photo: Michał Miazga)

↑ The bitterling – a small fish found in Kampinos which needs mussels for reproduction (photo: User: Ostjan / Wikimedia Commons / CC-BY-SA-3.0)

↓ Various forms of the planned naturalisation of Kampinos' canals: groynes on the margins, central spit, modification of the bank line, deflectors made of deadwood.
(© Michał Miazga)

The canals in the Kampinos Forest are entirely artificial, dug in the 19th and 20th centuries. Before they were built, the outflow of water from the area of the forest was in the form of surface runoff and took place only during periods of high water. Even today, water in the canals flows mainly during periods of high water. Afterwards, the water level drops almost to the bottom and the flow dies down, often for up to six months each year. This nature of the flows means that the Kampinos' canals will never become natural rivers.
Under these conditions, the most effective measure to restore Kampinos to its original state would be to backfill the canals completely. Unfortunately, this is not possible. Although hydraulic modelling has demonstrated that only certain sections of the canals are necessary for the drainage of the Kampinos villages, the preservation of the continuity of the network is essential due to the concerns of local inhabitants who associate their flood safety with the existence of these canals. These concerns must be respected.
Under these circumstances, as part of the "Kampinos WetLIFE" project, in addition to the construction of 13 impounding structures on the Zaborowski Canal and the Łasica Canal providing water for the wetlands (see Chapter 13), the decision was made to naturalise about 8.5 km of the canals. Light groynes made of wooden stakes will be built in the canals, as well as berms made of soil and branches, and in some places the banks will be remodelled to disrupt their straight lines.

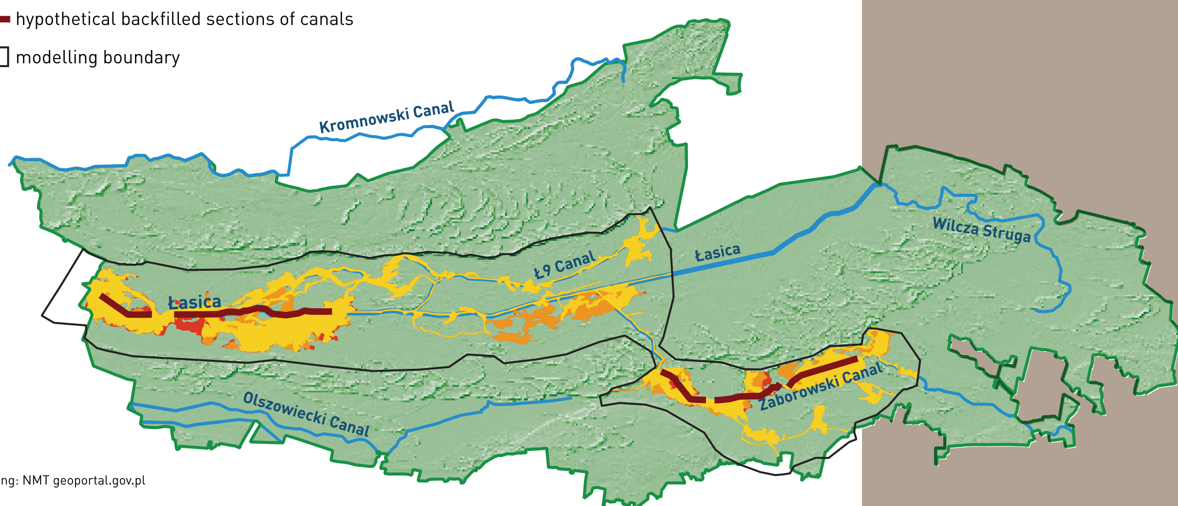


These measures will cause water that has hitherto flowed steadily through the straight canals to accelerate in some places and slow in others, while changing its direction. This will be particularly noticeable in the case of low and medium waters and will result in a kind of micro-meandering of the canals, the scouring of certain parts of the banks, the creation of shallows and deeps and, consequently, the improvement and diversification of aquatic habitats. There will be places where the water will flow vigorously over a sandy bottom and sections where living conditions will be more like in a calm lake.

↑ The Łasica Canal near Pieklice. Unfortunately, this canal is still straight with even, steep banks, despite the fact that its maintenance works were abandoned over 20 years ago. (photo: Michał Miazga)

Expected increase in floodplain area because of hypothetical backfilling of parts of Kampinos canals, not planned under the project (results of modelling for high flows). Both in the case of the ongoing project and the hypothetical backfilling of parts of the canals, the increase in waterlogging concerns only the areas already repurchased by the Kampinos National Park).
(©Karol Kaszyński based on hydraulic modelling)

- current floodplain
- increase of the floodplain area after the implementation of the 'Kampinos Wetlfe' project
- hypothetical increase in the floodplain area after removal of some of the canals
- hypothetical backfilled sections of canals
- modelling boundary



shading: NMT geoportal.gov.pl

WHAT LIVES IN KAMPINOS' CANALS?

Large numbers of pike flow into the Łasica Canal in spring, spawning in the open wetlands. Locals tell us that decades ago, before the pumping station at the estuary of the Łasica into the Bzura River was built, there were so many pikes that they could be caught in an ordinary wicker basket. At that time there were also burbot here, famous for their tasty meat.

Although burbot (Lota lota) have not been seen here for a long time, the canals are still home to valuable fish species. The Amur bitterling (Rhodeus sericeus), a small, protected fish, has an extremely interesting way of reproduction. It spawns inside live mussels, where the larvae develop before feeding. The weatherfish (Misgurnus fossilis) lives at the bottom of the canals among the silt and plant debris, hence it is difficult to spot. However, during the dredging of the Ł9 Canal, there was an incident where their wintering grounds were encountered. Hundreds of weatherfish came out of the spoil pulled ashore. The works were of course interrupted. It is interesting to note that weatherfish in Kampinos are the basis of the local black storks' diet.

Ponds of Diversity

↑ A small pond during a drought in 2023 (photo: Michał Miazga)

↑ A disappearing pond in the region of Pieklice (photo: Michał Miazga)

↑ Graphoderus bilineatus (photo: @User: Yerpo / Wikimedia Commons / CC-BY-SA-4.0)

In the early days of the Kampinos Forest, the area featured more small bodies of water than it does today. This was due to the fact that the primeval, still fresh topographical relief formed by the end-of-ice age Prawisła River was sharper than today. The depressions in the marshy zones were once deeper and broader, and the water table stood higher. As a result, the forest was dotted with smaller and larger ponds that offered habitats for a variety of wetland animals. Over time, these ponds became shallower, gradually filled in by vegetation and sediment as water levels dropped. When humans arrived, they began extracting peat, leaving behind broads. Around villages, people created fishponds and watering holes for cattle. In time, these turned into valuable ecosystems. But later, as the population of the neighbouring areas decreased, they began to vanish. This was how amphibians lost their breeding grounds and what deprived larger animals of natural water sources needed to survive summer heatwaves. Aquatic invertebrates also lost their habitats. Humans pay them little attention, but within this group there are also some rare and endangered species. One example of such an invertebrate is Graphoderus bilineatus. This predatory water beetle, closely resembling the great diving beetle (Dytiscus marginalis), is known today to inhabit only one pond in the Kampinos Forest. A dragonfly, the large white-faced darter (Leucorrhinia pectoralis), is in a similar situation. Incidentally, it resides in the same pond as the aforementioned beetle.

As part of the Kampinos WetLife project, 35 new ponds will be created. These will be small reservoirs, ranging in size from 20 to 400 square meters.

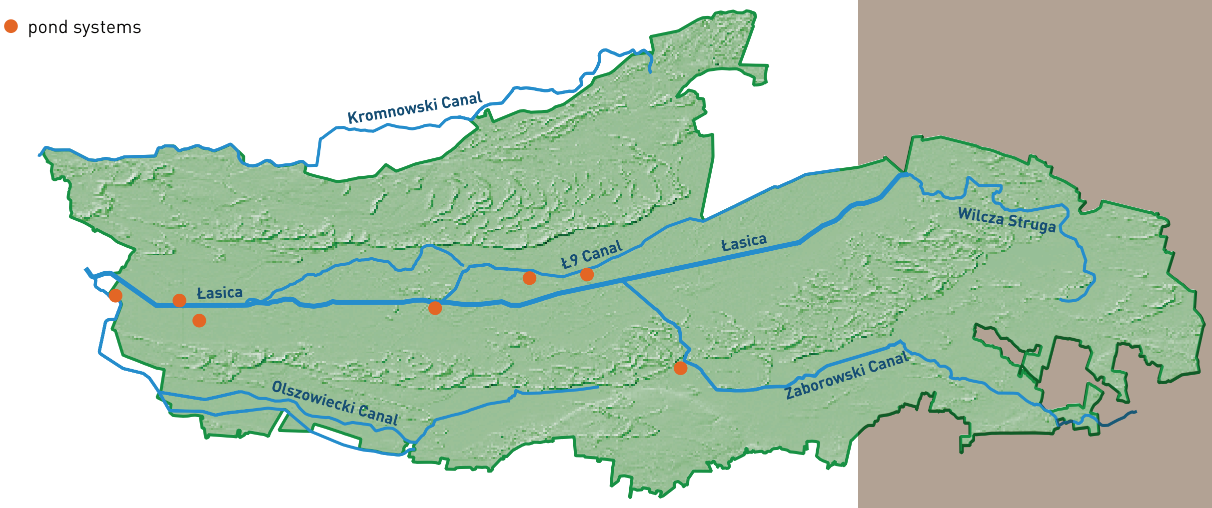
They will be located near Łubiec, Nowa Dąbrowa, Nowe Budy, Zamość, Pieklice, Władysławowo, and Sianno. The ponds will have gently sloping banks, which will allow the aquatic plant life to flourish. They will be relatively well exposed to sunlight, and so their water will warm quickly, which is what most aquatic organisms thrive on. These bodies of water will be fairly shallow, so they dry up every few years. This natural drying process will prevent them from becoming stocked with fish. For fish can be devastating to the spawn of rare amphibians, whose life cycles heavily depend on the ponds.

THE WATER BAT

It may come as a surprise, but creating ponds is also an important part of bat conservation, especially for the Daubenton's bat (Myotis daubentonii). Not only do these bats hunt near bodies of water and drink from them (as most bats do), but they also specialize in hunting directly from the water's surface. This is why their feet, tipped with sharp claws, are larger than those of other bats. The Daubenton's bat's prey includes lake flies (Chironomidae), caddisflies (Trichoptera), and various crustaceans. Occasionally it may also hunt small fish.

← A Daubenton's bat (Myotis daubentonii) hibernating in a root cellar adapted for bats in the Kampinos National Park (photo: Adam Olszewski)

Location of planned pond systems
(©Karol Kaszyński)



Combating Invaders

↑ Most invasive plants are simply beautiful, which is why people have spread them far beyond their natural range. The northern red oak (Quercus rubra) is now the most widespread non-native tree species in Poland. Its abundant, slowly decomposing leaves inhibit the growth of other plants.
(photo: anmbph/Shutterstock.com)

Not all plant and animal species found in the Kampinos Forest are native to Poland. Most of these alien species were brought here by humans from East Asia or North America. Some of them pose a threat to local ecosystems – they are called invasive species.

At present, invasive species are causing significant harm to native habitats in certain areas of the forest. Invasive goldenrods – tall goldenrod (Solidago gigantea) and Canada goldenrod (Solidago canadensis) – have taken over many local grasslands, displacing native plants such as buttercups (Ranunculus), ragged-robin (Lychnis flos-cuculi), and dozens of others. The American waterweed (Elodea canadensis) has become so abundant that in the summer it fills entire water channels, hindering the development of our coontails (Ceratophyllum), arrowheads (Sagittaria sagittifolia), and the rare water crowfoot (Ranunculus subgen. Batrachium). Inside the forest, black cherry (Prunus serotina), black locust (Robinia pseudoacacia), and northern red oak (Quercus rubra) are now widespread.

Among the invasive animals, raccoons and American mink are particularly destructive. They are predators closely tied to aquatic environments. Mink feed mainly on amphibians, fish, molluscs, and during bird nesting season, also prey on eggs and hatchlings. Raccoons are predators as well, but omnivorous. They prey mainly on small animals, but they also eat insects, carrion, fruit, and nuts. They are agile climbers, easily moving through the treetops.

↑ An American mink (Neogale vison) on the Lasica canal in Górki village
(photo: Adam Olszewski)

The Kampinos WetLife project includes a wide range of efforts to reduce invasive species populations. Much attention is focused on limiting the numbers of mink and raccoons. Both are captured and euthanized according to carefully planned procedures, carried out legally and under the supervision of a qualified veterinarian. After euthanasia, the animals are tested for parasites, viruses, and other diseases – especially those that could potentially spread to native species, domestic animals, or humans. Killing these animals is a highly sensitive issue, as it is not their fault they ended up where they cause harm to local wildlife. Unfortunately, they have become so numerous that capturing them is now a necessity, and there are no reserves where they could peacefully live out their lives.

Invasive plant species are also being fought. The population of invasive goldenrods (Solidago) is controlled through biannual mowing, repeated over a period of three to four years. Black locust, northern red oak, and black cherry are cut down, uprooted or cleared, and their regrowth is removed over the following years. The most laborious fight, however, is the management of some invasive herbaceous species. For instance, eliminating the wild cucumber (Echinocystis lobata) – a vine with distinctive prickly fruits – can require cutting it down as many as five times per year, repeated over many years with gradually decreasing frequency.

WHY ARE INVASIVE PLANTS SO DANGEROUS TO NATIVE SPECIES?

- They have no natural enemies, other species have not yet learned to compete with them or feed on them.
- They can tolerate poor growing conditions, including very cold weather or drought.
- They grow quickly, outcompeting other plants and often forming single-species areas.
- They produce many flowers and seeds, spreading easily to new areas.
- They often look nice and produce nectar, so they are planted in gardens, from where they quickly spread to other habitats.
- They can release chemicals that inhibit the growth of other plants.

← Area after removal of invasive tree species. Here, black locust and northern red oak are cut at a height of approximately one meter, which inhibits regrowth and facilitates their elimination. (photo: Agnieszka Gutkowska)

Goldenrod (Solidago)

Knotweed (Reynoutria)

Wild cucumber (Echinocystis lobata)

↑ Invasive plants are difficult enemies who displace native species – they can even threaten human infrastructure. Invasive goldenrods quickly colonize large, unused or late-mowed areas, leaving no space for other plants. Knotweeds produce sturdy rhizomes that can crack through concrete and asphalt, reaching up to several meters underground. Wild cucumbers can grow stems as long as 8 meters in length, climbing over other plants and blocking their access to sunlight, often causing them to wither. (photo: Agnieszka Gutkowska)

Supporting Habitats

↑ Polish Konik horses grazing on Kampinos grasslands. This primitive Polish breed descends from tarpans, once native to Europe's forests. These resilient horses, well adapted to harsh conditions, greatly help manage both forest and non-forest habitats in various national parks. They are now helping to protect Kampinos grasslands as well.
(photo: Joanna Pachowska)

The protection of Kampinos Forest habitats within the project focuses primarily on improving their water conditions. Other active protection measures are also being taken to support valuable habitats and their species.

Initial mowing is carried out mechanically using equipment adapted for wetlands or manually in places inaccessible to such machines. It is implemented on degraded patches of highly valuable purple moor grass and fresh meadows, which, due to abandonment, are subject to degradation and succession. In areas where meadows have already become partially overgrown with shrubs and young trees, de-shrubbing is performed. It is necessary for mowing to resume. To support biodiversity (especially of fauna), individual native trees, such as hawthorns (Crataegus), junipers (Juniperus), or fruit trees, are left standing.

↓ A molinia meadow with fluctuating moisture levels protected under the EU Habitats Directive, before and after initial clearing and mowing.
(photo: Agnieszka Gutkowska)

On one of the grasslands where mowing was resumed, a pair of lapwings nested the very next year. Host species of valuable butterflies are present in some patches of grasslands, including devil's bit scabious (Succisa pratensis) for the marsh fritillary (Euphydryas aurinia) and great burnet (Sanguisorba officinalis) for the scarce large blue (Phengaris teleius).

A pilot program of extensive grazing in the Kampinos's non-forest ecosystems uses native livestock (cattle, horses). In the past, grazing was common throughout the area. Nowadays, it continues only on a small scale, mostly on private land. Grazing shapes unique pasture ecosystems, forming habitats for many species of animals, among which are amphibians and wading birds. Some valuable semi-natural plant communities (forest and non-forest), for instance open woodlands and greenswards, strongly depend on this form of protection. The selected pilot grazing areas feature a mosaic of habitats (fresh and wet meadows, greenswards, and reedbeds), which is typical of the Kampinos Forest. Small ponds within the pastures will provide opportunities for beneficial interactions between grazing animals and amphibians.

Species enrichment on grasslands takes place primarily on wet meadows, characterized by relatively low biological diversity resulting mainly from inadequate water relations and local abandonment of their cultivation in the past. This is done by light cultivation (in a way adapted to local soils) and sowing additional species, characteristic or typical of selected habitats, that is wet and fresh meadows, and host plants for butterflies protected by the Natura 2000 network. Seeds used for sowing come from the most botanically valuable grasslands of the Kampinos Forest.

PROTECTED WETLAND PLANTS

Supporting habitats also improves conditions for plant species that depend on them. In the areas covered by the project, there can be found rare and protected species typical of wetland habitats, including species under strict protection, species requiring active protection, and endangered species, listed in the Polish Red Data Book of Plants, such as: marsh angelica (Angelica palustris), Siberian iris (Iris sibirica), fringed pink (Dianthus superbus).

Additionally, marsh angelica has the status of a Natura 2000 species, meaning it is of communal importance. It is also listed in the Berne Convention.

↓ Examples of rare and endangered plants whose populations require support.
(photo: Agnieszka Gutkowska)

Marsh angelica

Siberian iris

Fringed pink

Protecting Animals

↑ A young northern crested newt with external gills still visible. The newt hatched at the amphibian breeding centre at the Warsaw University of Life Sciences (SGGW) from eggs collected in the Kampinos Forest. Once it matured, it was released at the original egg collection site. (photo: Krzysztof Klimaszewski)

↑ A ramp helping amphibians leave their wintering site in a root cellar, a remnant of one of the former Kampinos villages. (photo: Karol Kaszyński)

The Kampinos WetLife project helps wetland species primarily by extending the duration of spring flooding and stabilizing water levels. However, some rare species of animals require additional support. Therefore, specialized conservation measures were planned for the protection of two bird species, two amphibian species, and three mollusc species. All are subject to strict protection under the EU Birds and Habitats Directives.

As part of the project, 14 nesting platforms were installed in areas where previous breeding attempts by black storks (Ciconia nigra) and lesser spotted eagles (Clanga pomarina) had failed due to nest collapse. Despite the large number of old trees in the Kampinos Forest, the local nests of large birds remain structurally vulnerable. Both the black stork and the lesser spotted eagle are considered dual-habitat species, who require nesting trees within the forest during the mating season, as well as open wetlands where they can hunt. Each platform was equipped with a camera trap to allow monitoring of nest activity. So far it has been observed that black storks, common buzzards (Buteo buteo), and Eurasian goshawks (Astur gentilis) have already attempted to mate on the installed platforms. They are also visited by smaller birds and mammals, such as squirrels.

Special efforts were also undertaken to support the populations of the European fire-bellied toad (Bombina bombina) and the northern crested newt (Triturus cristatus). Eggs of these species are collected from bodies of water in the Kampinos Forest, and subsequently the individuals hatched under laboratory conditions are released back into the wild shortly after metamorphosis.

This helps reduce the high mortality rates that would otherwise affect the young. An important aspect of strengthening local amphibian populations has also been the creation of several dozen wintering sites using old root cellars remaining from the former forest villages. The cellars were equipped with planks, bricks, and loose soil to create suitable microhabitats for hibernation. Additionally, ramps were installed along the cellar stairs to help the amphibians exit safely in the spring.

The final task in this part of the project will be the reintroduction of three rare and endangered snail species: the narrow-mouthed whorl snail (Vertigo angustior), the Desmoulin's whorl snail (Vertigo moulinsiana), and the lesser ramshorn snail (Anisus vorticulus). Based on fossil mollusc studies we know that these species were once abundant in the Kampinos National Park, but today they are extremely rare. Their miniscule populations are at risk of disappearing due to random local events and a very limited gene pool. Therefore, it has been decided that 7 new subpopulations of the lesser ramshorn snail will be established, as well as 10 subpopulations of both whorl snails.

← Narrow-mouthed whorl snails captured near the bridge at Debły. Identifying the species of these tiny snails is possible only with the use of a stereomicroscope or a magnifying glass. (photo: Michał Miazga)

A SPOTTED MISMATCH

↑ A female greater spotted eagle from the Kampinos Forest, who for many years was paired with a lesser spotted eagle. (photo: Adam Olszewski)

Between 2013 and 2020, an unusual pair of spotted eagles nested in the central part of the Kampinos Forest. He, a lesser, and she, a greater spotted eagle. Year after year, they returned to the same nest and raised chicks together. Such pairings occasionally occur in the wild, especially in areas where the ranges of the two species overlap. The situation in Kampinos, however, is somewhat different, as the local population of lesser spotted eagles is small and geographically isolated from other subpopulations, while the closest greater spotted eagle nests are located far away in Podlasie. From the perspective of species conservation, the breeding of such a pair offers little benefit, since their offspring are not genetically pure. But in the wilderness, such situations are part of the natural order. Individuals of rare species may mate with their closest relatives. This nesting site is no longer active, because a white-tailed eagle (Haliaeetus albicilla) – a larger raptor that does not tolerate birds of prey of such a size in its vicinity – has since begun nesting nearby.

← A pair of black storks during courtship at a nest built on a platform constructed as part of the Kampinos WetLife project. (photo: Adam Olszewski)

THE KAMPINOS WETLANDS IN 100 YEARS

↑ The Kampinos Forest will provide vast areas where wildlife will thrive entirely on its own terms. This will be made possible by the Process Protection Zone (photo: Maciej Szajowski)

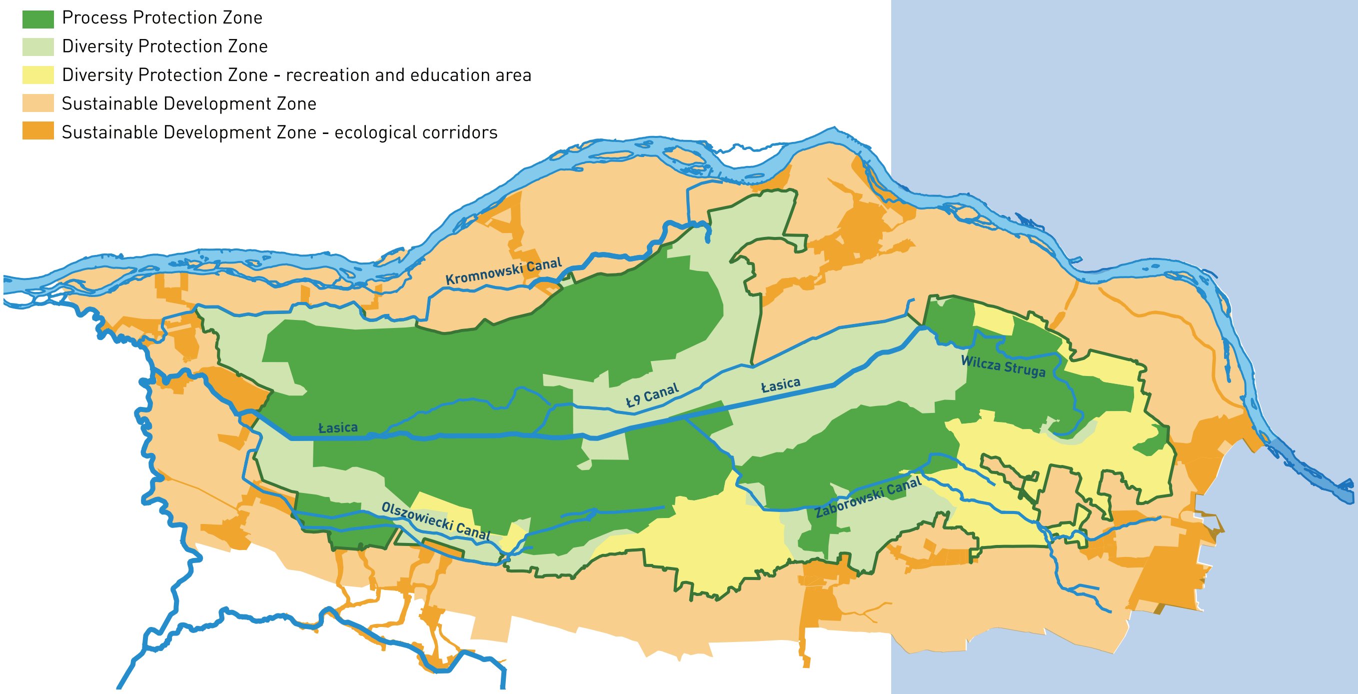
↑ The black-tailed godwit (Limosa limosa) and other endangered species requiring human support will be safeguarded in the Diversity Protection Zone, where a variety of active protection measures will be undertaken. (photo: Magdalena Sarat)

↑ Within the Diversity Protection Zone, canals and weirs will be maintained to allow effective water level management, considering the needs of protected species and habitats. (photo: Michał Miazga)

Before the Kampinos WetLife project came into being, a group of scientists and specialists from the Kampinos National Park, led by director Mirosław Markowski, undertook the task of developing a vision for the long-term state of nature conservation in the Kampinos Forest. This was essential to ensure that all conservation efforts in the area would have a singular common goal. Over the course of a three-day workshop, a group of 16 scientists and practitioners working in the area of animal and plant conservation – hydrologists, geologists, hydraulic engineers and experts on social issues – gathered to discuss what has been achieved in over 60 years since the establishment of the Park; where nature is still in decline, what threats and opportunities the forest may face over the next 100 years, and how it might change during that time. The group worked on a vision, an ideal future state of the forest, without being limited by current legal, financial, and organizational constraints. Adopting such a long-term perspective was meant to allow for breaking away from present-day limitations.

In the developed Vision, it was agreed that the wildlife of the Kampinos Forest would be protected not only as a human habitat or for the possibility of its continued economic use, not only for future generations or because of current trends or profits it may offer (e.g. ecosystem services), but for its intrinsic value – for the sake of its diversity and the continuation of natural processes. Nature, after all, naturally has value.

Concept of the target protection zones of the Kampinos Forest



This approach allowed for specific strategic decisions regarding the protection of the area's wetlands:

» It is necessary to slow the outflow of water from the forest and to expand the area of the long-term waterlogged habitats. Peat-forming processes should be restored, while soil degradation halted.

» The wetland water supply system should be adapted to absorb the growing water load from increasingly urbanized neighbouring areas.

» Wetland vegetation should form a natural mosaic including wet forests, oak-hornbeam forests, reedbeds, peatlands, meadows, and pastures, ensuring both resilience and adaptability to climate change.

» The Kampinos Forest should serve as a protection zone for natural processes and as a refuge for species and ecosystems disappearing elsewhere. These are two fundamentally different approaches to conservation. This requires designating around 50% of the area as a Process Protection Zone (PPZ), where wildlife will govern itself without human intervention, and a Diversity Protection Zone (DPZ), where selected species and habitats will be actively protected.

» The forest will be accessible for tourism and leisure, while still maintaining sufficiently large areas for wildlife undisturbed by human presence.

» The forest will maintain ecological connectivity with other biologically important areas, in order to facilitate species migration and genetic exchange between populations. Wildlife corridors will have legal protection to ensure their long-term viability.

↑ In the Process Protection Zone, after initial naturalization and construction of a range of impounding structures, the canals will be surrendered to the forces of nature. This Zone will be designated in such a way that the natural transformations of its waterways shall not elevate flood risk for the residents living in the vicinity of the forest. (photo: Michał Miazga)

↑ Vistula's oxbow lake. In the Sustainable Development Zone, large green spaces will be preserved to ensure a high quality of life for people and to serve as buffer zones for the wildlife of the Kampinos Forest. (photo: Adam Olszewski)

One of the key conclusions of the Vision is the need to revise the current zoning system of the Kampinos National Park. At present, the forest area is divided into zones of strict protection, active protection, landscape protection, and a buffer zone. It is proposed that this division should ultimately be replaced with the following system:

↑ Haystacks
(photo: Andrzej Pachowski)

1. The Process Protection Zone (PPZ). This zone will encompass large and ecologically diverse areas that allow natural processes to unfold freely, without generating conflicts with local communities or tourism. Natural processes such as windfalls, tree dieback due to aging or changing water levels, fires, and insect outbreaks will lead to spontaneous regeneration and naturalization of habitats. Large herbivores and beavers will play a crucial role here, with their populations regulated by natural factors. Herbivores will help slow down succession in open habitats and contribute to forest diversification. Ultimately, only emergency interventions will be carried out in this zone, for example in situations posing threats to human life or health. A significant portion of this area will be closed to tourism to ensure adequate conditions for animals avoiding human contact. Water systems in this zone should undergo rewilding – braided river flow must be reintroduced, smaller drainage channels filled or blocked, permanent weirs constructed on main canals, and natural channels restored. Once these measures are in place, water dynamics in the zone should be left to natural forces, while ensuring flood safety for local communities. This zone will be an extension of the currently functioning areas of strict protection.

↑ Willow pollarded
(photo: Andrzej Pachowski)

2. The Diversity Protection Zone (DPZ). The primary purpose of this area will be the protection of the diversity of endangered species, ecosystem mosaics, the landscape, and cultural values. Here it will be possible to apply various active protection measures. Elements characteristic of the Masovian landscape, such as haystacks or pollarded willows, will be preserved. Water management will be adapted to the needs of selected species and habitats, simultaneously ensuring good living conditions for communities neighbouring the forest. Within this zone, there should exist a network of drainage infrastructure allowing for effective regulation of surface water levels. Canals and ditches will be transformed to resemble natural watercourses as closely as possible, while still allowing flow regulation. Tourism will be permitted in this zone, with designated spaces for environmental education and leisure, located in areas with convenient access to transportation, concentrating tourist activity. The Diversity Protection Zone will be the equivalent of current active and landscape protection zones.

↑ Backwater effect of beaver activity (photo: Andrzej Pachowski)

3. The Sustainable Development Zone (SDZ) covers the buffer area surrounding the Kampinos National Park. This zone will grow in accordance with the principles of sustainable development, serving as a protective buffer for the Kampinos Forest. The area should be characterized by a high quality of life for inhabitants, with ample green spaces, areas for agriculture, numerous small bodies of water, and preserved natural and cultural assets. Much attention will be given to water management, ensuring rainwater infiltration and preventing local flooding. Ecological corridors in this zone will be protected and maintained through appropriate spatial planning and legal safeguards. Natural assets, particularly those in the floodplain terraces of the Vistula and Bzura rivers, will be actively protected. Within this area, collaboration with local governments and communities will be essential, regarding land planning and management.

The full version of The Vision is available at www.kampinoskiebagna.pl.

We hope that the implementation of the Kampinos WetLife project will allow the local wetlands to come closer to the ideal state described above. We hope that our efforts will help increase the amount of water in the forest and prevent it from disappearing so quickly during heatwaves. We also hope that with a bit of our help, black storks, newts, peat mosses, marsh cinquefoils, and other wetland species will not only survive, but that their populations will grow stronger and adapt to life in today's world. And perhaps someday other species once driven out of the Kampinos Forest by civilization will return? The Eurasian curlew, the aquatic warbler, sundews, or maybe the European pond turtle? Time will tell.

Dear Readers!

We are offering you a publication presenting the most important aspects of the water cycle in Kampinos Forest (Puszcza Kampinoska) and describing the activities conducted under the LIFE project Kampinos WetLife. A similar brochure was published in 2017 as part of a previous project protecting the Kampinos wetlands. Since then, however, knowledge of the wetlands of the Kampinos National Park has increased significantly, which has allowed us not only to expand the content of this publication but to plan further conservation activities for these areas. We hope that this brochure will facilitate conversations about water between various people connected to the Kampinos Forest and allow them to better know and understand the actions taken to protect valuable wetland habitats.

The Kampinos WetLife project aims to improve the condition of wetlands by increasing their moisture content, naturalising watercourses, building ponds, repurchasing land, holding educational activities, as well as several projects supporting various endangered species. These activities would not have been possible if it were not for a group of wonderful people supporting this initiative: the inhabitants of the forest villages, local government officials, scientists, civil servants, and volunteers. We would therefore like to take this opportunity to thank them all sincerely. Without you all, this project would not have happened. Thank you!

Anna Wilińska (KPN)

Michał Miazga (REC Polska)

REGIONALNE CENTRUM EKOLOGICZNE
REC Polska

Kampinoski Park Narodowy