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PLACEMENT OF PLANTS IN COMBINATION WITH SCULPTURES NEAR WATER BODIES IN THE IMPROVEMENT OF SUBURBAN PARKS

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Abstract

Aquatic systems play a vital role in the development of civilization and have significant socioeconomic significance. Freshwater ecosystems provide a wide range of vital services that benefit communities.

Public spaces are centers of individual and social well-being, places of collective life where the expression of various intangible values becomes most tangible. The modern city is the epicenter of economic and social life. It is not only a place where people live but also a hub for various activities (leisure, work, etc.). In this context, suburban parks with small ponds are an integral part of maintaining an attractive environment. However, it should be noted bodies of water are subject to significant anthropogenic impact and are often in a state of degradation.

This article examines some issues related to the creation and maintenance of suburban parks with ponds.

Keywords: recreation, water, urban environment, pond, bioplateau.

Introduction

Recreation is a set of activities aimed at maintaining well-being, spirit, and productivity. However, due to the constant clearing of green spaces in large cities, finding natural habitats is becoming increasingly difficult.

Ponds make a significant contribution to global biodiversity in heterogeneous environmental conditions [1]. Small urban water bodies facilitate the formation of plant and animal biotopes in urbanized areas, often with a fairly diverse biotic component. Some researchers view the areas around these bodies as refuges, where diverse plant and animal species survive in urbanized areas. However, some biotopes create conditions for the life of organisms whose mass development or unbalanced increase in their numbers in cities is undesirable. These species can be roughly divided into three groups [2]:

- organisms whose mass development degrades the ecological state of urban water bodies and their social attractiveness;
- organisms whose development worsens the sanitary and epidemiological situation;

- organisms whose excessive increase in numbers can lead to a decrease in the biodiversity of urban biota.

The primary focus should not be on various methods for eliminating these organisms, but on creating conditions that prevent their development. At the same time, measures must be taken to combat the mass development of unwanted organisms and limit the numbers of individual species [3].

A natural body of water is a biologically balanced ecological system, designed for self-purification and self-regeneration. A wide range of aquatic organisms—planktonic and benthic microorganisms, higher aquatic plants, and fish—form the foundation of the body of water's ecosystem. The physicochemical and biotic processes occurring within the aquatic ecosystem are the primary mechanism for the body of water's self-purification. The term "water self-purification in ecosystems" implies that water is purified through a series of ecological processes involving the many aquatic organisms that form these aquatic ecosystems. Water self-purification processes in ecosystems are important for the stability of aquatic ecosystems, maintaining water quality, and maintaining biodiversity. Reservoirs with impaired microbiological self-purification are more quickly oversaturated with unoxidized organic matter and biogenic elements, which irreversibly leads to their eutrophication, i.e. a change in the type of aquatic ecosystem occurs. Unlike a natural body of water, an urban water body can be assessed from several perspectives simultaneously. In addition to the environmental aspect of the problem, there are almost always a number of other aspects: medical, cultural and historical, technical and operational, and socio-psychological. Most small urban water bodies are at such a stage of anthropogenic degradation that environmental protection measures alone are insufficient to restore them to a comfortable living condition. This typically requires specialized engineering and environmental measures. Modern urban water bodies are one component of the urban system. Their condition largely determines the social attractiveness of a particular urban development, its so-called «video ecology». Water bodies play a significant role in shaping sanitary and hygienic conditions in cities and can even serve as sources of infectious disease transmission [2].

The processes that facilitate the "self-purification" of water in a natural reservoir include physical, physicochemical, and biochemical processes [4, 5]:

- filtration of the water column by aquatic organisms;
- dissolution and dilution of pollutants in the water column;
- sorption processes by suspended matter, microorganisms (plankton, benthos), aquatic organisms (phyto- and zooplankton, plants), and bottom sediments;
- photochemical and catalytic reactions, oxygen evolution, and oxidation;
- release of nitrogen and phosphorus compounds by biota, which are used by algae, which in turn release oxygen to oxidize pollutants.

Solving the problems of environmental rehabilitation of water bodies will require development of regulatory documentation governing the performance of work on the following issues [6]:

- comprehensive biological survey of the coastal zone and water area of the water body, including biotesting methodology;

- methods for calculating frost heave of loamy soils in the water-shore contact zone;
- sanitary and environmental survey of the water body and coastal zone;
- calculation of frost heave characteristics of loamy soils in the watershed zone of the water body to address pile wall design issues;
- development of water management calculation methods applicable to small water bodies and watercourses located within urban areas;
- development of regulatory documentation governing the design of bioengineering structures:
- coastal protection structures;
- hydrobotanical sites and bioplateaus;
- development of regulatory documentation governing the technology for forming a reservoir ecosystem depending on the physical, geographical, and morphometric conditions, anthropogenic loads, and other characteristics of the territory;
- development of regulatory documentation governing the implementation of comprehensive monitoring of a water body during the operational phase to assess the degree of restoration of the hydroecosystem.

The technology assumes that significant improvements in water quality in the reservoir occur within 2-3 years after the intervention. The following measures are necessary during the first 2-3 years: polluted surface runoff entering the reservoir is cut off; systematic monitoring of the hydrochemical and hydrobiological parameters of the water is conducted; in winter, it is advisable to provide for aeration of the reservoir using specialized equipment; in the spring, if necessary, additional stocking of individual fish species, stock cultures of forage invertebrates, and replanting of poorly overwintered plants should be carried out. To create a natural hydroecosystem in a pond, the following measures are proposed [7]:

- Water hardness must be reduced and free carbon dioxide levels must be increased to levels necessary for the normal development of ornamental plants. For this purpose, it is recommended to replace the limestone rubble in the rock fill on the underwater slope of the pond and in the stream bed with zeolite, which is a good sorbent.
- Free CO2 levels should be increased by lowering the pH and increasing the stocking density of aquatic organisms and fish.
- To acidify and desalinate the water, it is necessary to minimize the direct supply of artesian water to the pond and organize water circulation using a filtration system;
- To create a favorable gas exchange regime in winter, a compressor must be installed.

Water is the primary factor through which most people and the environment are likely to experience climate change.[1]

Freshwater ecosystems are particularly sensitive to warming because their chief drivers, water quality and water quantity, are strongly influenced by atmospheric temperature regimes. Air temperature determines both water temperature and many chemical attributes contributing to water quality (e.g., dissolved oxygen levels), and its suitability for supporting freshwater biodiversity and maintaining critical ecological functions and services. Surface and ground water regimes, including precipitation, snow melt, run-off, soil moisture, river discharge, and

[1] World Meteorological Society (2021)

aquifer recharge, are similarly sensitive to warming, with significant changes to hydrology attributed to temperature increases already apparent across the world [8]. Current global ambitions for climate change mitigation to limit planetary warming to 1.5° C, an objective since the 2015 COP21 Paris agreement, dramatically reduce the extent and magnitude of climate risks faced by freshwater ecosystems, although these remain significant [9].

The region is already experiencing significant climate change. In particular, in Stepanakert, the average annual temperature increase over the past 50 years has been 1.3^0 C. During the same period, the average monthly temperature rise in Stepanakert reached 3.2^0 C (Fig. 1) [10].

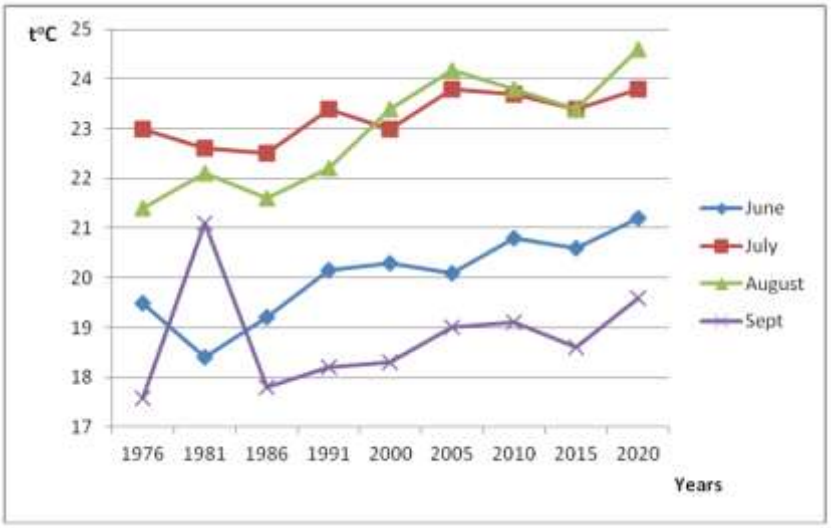

Fig. 1. Dynamics of annual change in average monthly temperature in Stepanakert during the summer period

Of further concern, however, is the additional threat to freshwater ecosystems presented by human responses to climate change (e.g., dam building for water security, meeting increased water demand for cooling), including many of the mitigation approaches being pursued to limit global temperature rise to 1.5°C (e.g., increasing hydroelectrical power generation, carbon sequestration plantations).

Freshwater ecosystems are highly vulnerable to global warming because 1) their chief drivers, water quality and flow regimes, are highly sensitive to atmospheric warming, and 2) they are already extremely threatened by a wide range of interacting anthropogenic pressures. Even relatively modest global warming of 1.5°C poses a considerable threat to freshwater ecosystems and the many critical services these provide to people. Shifts in the composition and function of freshwater ecosystems are widely anticipated with adverse consequences for ecosystem services, including those underpinning water and food security. While the extent and severity of effects is likely to be significantly reduced if global warming is limited to 1.5°C, concerted efforts to implement widely recognised priorities for policy and management are required to mitigate unavoidable impacts and reduce the likelihood of perverse outcomes of climate mitigation and adaptation efforts in other sectors—all of which rely on fresh water supply. Freshwater ecosystems and their services, including provision of fresh water, must therefore be considered first and foremost when developing and implementing any climate action. The quality of aquatic ecosystems can be assessed using chemical, physical, and biological parameters. Exceeding established parameter values poses a danger to living organisms inhabiting the ecosystems [11]. Global warming of 1.5°C has many implications for

freshwater ecosystems, with effects varying regionally, in relation to climate, and locally between different habitat types [12].

Strong relationships exist between climate change mitigation and adaptation and the management of water resources and freshwater ecosystems [13]. Consequently, it is critical that freshwater ecosystems and the many services these provide, including provision of fresh water, are considered first and foremost when developing and implementing any climate action [13, 14].

It is now almost inevitable that by some time in the middle of this century (2041–2060), global temperature will exceed 1.5°C warming relative to a 1850–1900 baseline, after which it will either stabilise or, in all but the very lowest emissions scenarios, continue to rise [15]. The vulnerability of freshwater ecosystems to warming is exacerbated by their disproportionately high levels of modification and degradation which both aggravate their sensitivity to temperature change and constrain their capacity to autonomously adapt [16].

Despite widespread acknowledgment of the pivotal role of freshwater ecosystems to the world's future under climate change, substantial knowledge gaps remain. Furthermore, conservation policy and management of freshwater ecosystems are often buried within a broader dialogue concerning terrestrial conservation, or else obscured by an overly narrow focus on meeting human water demands [11].

Suburban parks are an integral part of recreational areas. They serve as ideal centers for meeting the non-material needs of society, where citizens of all ages and interests can find satisfaction. Suburban parks are typically built near bodies of water, and where these are absent, artificial reservoirs are constructed within the area. Water, pathways, works of art (sculptures, music), diverse flora and fauna, play areas, service outlets—this combination can satisfy even the most daring public desires.

Conflict Setting

The goal of creating "green" communities is to harmoniously combine natural and spiritual values. When designing recreational areas, it is necessary to consider the full range of challenges facing the urban environment. Particular attention should be paid to increasing the area of green spaces and water bodies, while simultaneously meeting the functional and social needs of the population. It is important to recognize that small bodies of water play a vital role in suburban parks, although they are primarily subject to significant anthropogenic impact and are often in a state of degradation. Therefore, the development of new water purification technologies is necessary for the environmental rehabilitation of small bodies of water. A comprehensive study of the ecological and hydrobiological parameters of small bodies of water, taking into account Yerevan's natural conditions, will enable the development of a sound approach to the creation and operation of suburban parks.

Research Results

A multifunctional park is a landscaped, green area designed for recreation, public events, cultural and educational activities, sports and fitness, and entertainment for visitors of various age groups. They are characterized by the mandatory presence of recreational

infrastructure elements (paths, playgrounds, lighting, hardscape, attractions, buildings and structures for cultural events, games, and sports). Catering and retail facilities may also be located to service the park's territory [17]. The sculptor's creative work is intended to provide an additional emotional charge to people who expect emotional intensity and the expression of outstanding spiritual achievements from his works. Decisions regarding the installation of monuments in urban environments are aimed at creating psycho-emotional comfort. They must integrate into the public space and become an integral element, whose function is to imbue the urban environment with an aesthetic component. This approach is especially important when landscaping suburban parks [18, 19].

Classical garden and park sculpture made of natural stone and bronze remains in demand [20]. Each sculpture is unique and inimitable. Monuments based on classic works of world literature are especially significant. When placed in a park, these monuments imbue it with the mysterious atmosphere of fairy tales, poems, and ballads.

Fig. 2 shows a sculpture of a character from Hovhannes Tumanyan's poem «Sako from Lori» (sculptor: Baghdasaryan Sargis), about a shepherd whose heart breaks after an encounter with ghosts. For some reason, the shepherd decides to return to the village, and Sako is forced to spend the night alone in the shepherd's hut. Such huts can still be found high in the mountains today—shepherds spend the night there or even live for several days. And so, young and strong Sako, left in silence, begins to grow afraid. He recalls his grandmother's stories of encounters with ghosts. Eventually, these same ghosts appear to him.

Fig. 2 Example of development of suburban parks

First, Sako hears someone walking around the hut. Then the door swings open and the spirits rush in. Sako, terrified, flees from them and jumps into the Debet River. What is this? Society has been astonished for many years, unable to understand the meaning of the poem. Everyone tried to figure out what Tumanyan was trying to say. The main versions are that the poet was mocking a strong and powerful shepherd who died out of the foolishness of believing his grandmother's fairy tales. Another version is that it's a folkloric sketch. Tumanyan wrote the poem based on his notes—he went from village to village asking for local beliefs. Then he tried to reflect them as accurately as possible in his works. And this is precisely such a case. Why are the ghosts a group of women of different ages? The gist of it is that if a person is left alone at night in the mountains, certain spirits will come for him. And these aren't spirits in general, but specifically a group of female ghosts of different ages. The algorithm is quite predictable

for world folklore studies in general: spirits knock on the door. They're not simply inviting you to a wedding—they want to marry Sako himself to a beautiful spirits. A wedding in the spirit world means death on earth [21].

It remains unclear why this poem was taught for decades, even in schools. Did they think it was a good pedagogical move—that such a great man died of fear of nonexistent ghosts? But Tumanyan's text leaves no doubt that ghosts exist! And it's no coincidence that he spends so much time pondering why the shepherd Gevo suddenly left for the village—as if to suggest that Sako is destined to die that night [21]. Sako begins to have visions in which the door opens and women enter the hut. Sako runs through a dark valley. He believes evil spirits are chasing him. Thus, under the influence of fear, Sako loses touch with reality. Fig. 3 shows illustrations by People's Artist of Armenia Grigor Khanjyan.

Fig. 3 Illustrations by Grigor Khanjyan of the poem «Sako from Lori»

Every Grigor Khanjyan's illustrations could be displayed next to the "Sako of Lori" statue. In this setting, discussions could be organized with youth groups, including high school students, on the issues raised in the poem. The question arises: why is this necessary? What do we expect from these discussions? Over the past 30 years, the events unfolding in the South Caucasus, and especially in Nagorno-Karabakh (war, thousands of victims, blockade, famine), have negatively impacted the moral and psychological well-being of children and young people.

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The stressful context allows us to change the angle of view and fill with new content the clinical typology of adaptive behavior in depression, in particular such variants as a socially passive life position, refusal to fight for significant goals, small in depth and poor in content social contacts, protective and shielding with a “retreat to a small life” and dependent life [22].

Art therapy is widely used in psychology. It is used to treat neuroses, depression, phobias, stress, complexes, psychosomatic disorders, and crises, including age-related ones. Art therapy is especially effective for prolonged depression, when it is difficult to speak and analyze. Art therapy can also be successfully used with healthy clients and is especially popular among young people. Many people see no difference between art therapy and regular music, painting, or dance classes. Art in art therapy is a means of self-discovery [23]. Organizing such

discussions in suburban forests and parks is one of the goals of this work. One of the essential goals of art therapy is to create opportunities for active recreation for young people. In particular, creating the technical capacity for musical and theatrical events.

Well-maintained alleys are essential for organizing recreational areas for city residents, making strolls pleasant at any time of day. A park in the Art Nouveau style requires constant maintenance; all its elements must be not only decorative but also functional. Small architectural forms and accessories are more important than plants [24].

Fig. 4 Small architectural forms and accessories in the Art Nouveau style

The concept of a modern international park found its expression in the idea of the Parc de la Villette in Paris. Currently, the parks of Paris are mostly green spaces intended for strolls and recreation.

They are usually visited by children and the elderly. In winter and in bad weather, they are empty.

Fig. 5 Model stage for musical performances

Therefore, the need arose to create a universal park designed to serve all age groups, actively operating year-round, on weekdays and weekends until late in the evening, ensuring accessibility and safety.

The implementation of this idea was proposed through the organization of a science and technology museum, a music center with an exhibition hall. The scope of the project called for the construction of greenhouses: demonstration - with a cafe and rest areas, didactic - demonstrating new technology for growing various crops, practical use, where visitors can work; the creation of an «Astronomical Garden» with a radio telescope, observatory and meteorological instruments for the work of an amateur club, science clubs (modeling with workshops, a radio club, etc.); a system of water features; Activity centers for performances, concerts, fireworks displays, and public gatherings; theme gardens (e.g., scented gardens,

gardens of unusual plants, mythological gardens); a wide service system—kiosks, cafes, and rentals of sports equipment and tools. In recent years, wild gardens have become widespread. In them, plants are placed seemingly chaotically, but this chaos is planned and created to create the illusion of natural, wild nature, so lacking in modern urbanized man. Flora in landscape gardening of the 20th century mainly uses local planting species, and is sometimes combined with artificial plants. Parks include open spaces for recreation, various flower beds, ponds, as well as enclosed spaces: forests and groves [24].

Parks have their own unique design, operation, and safety features. All aspects of creating recreational areas revolve around ensuring the most comfortable recreational conditions, including safe movement of people within the park while minimizing harm to the ecosystem.

Fig. 6 Illuminated alleys in the park area

A small urban water body is defined as any body of water or watercourse, partially or completely located in an urbanized area, the size of which is comparable to the main elements of urban development - buildings, structures, and transport highways. Many small water bodies are parts of the city's hydrographic network, receiving its runoff and transporting it to a specific river basin [2].

Recreational use of aquatic ecosystems primarily involves the waters of reservoirs. Ensuring the safe operation of small artificial reservoirs that lack adequate water circulation is particularly important. A common characteristic of aquatic ecosystems is their sensitivity to pollution, changes in hydrological regimes, and the extraction of bioresources. Anthropogenic pollution of water bodies has significantly exceeded natural sources in recent decades.

The ecological state of water bodies shows that the water area adjacent to recreation areas is dominated by plants that indicate low water quality. Furthermore, small bodies of water subject to uncontrolled pollution have become a major factor in the deterioration of the sanitary and epidemiological situation in cities. Therefore, the restoration of small bodies of water and waterways is gradually becoming a priority for urban development [25, 26].

Recent decades have been characterized by a sharp increase in anthropogenic pressure on water bodies and waterways. The quality of the aquatic environment is deteriorating progressively, posing a threat to the planet's environmental, food, and national security. The widespread degradation processes occurring in the hydrosphere are leading to various events and phenomena. The ever-increasing level of anthropogenic impact on the environment is leading to environmental degradation, defined as a deterioration in the quality of the human

habitat, characterized by a cumulative deterioration of natural and social conditions [2, 25]. During a 10-minute swim, a person introduces over 3 billion saprophytic bacteria and from 100 thousand to 20 million E. coli into the water. With the increase in the number of swimmers, an increase in the concentrations of nitrates, mineral phosphorus, sodium and sulfates in the water of the reservoir is observed. However, mass swimming is not a significant source of water pollution in terms of bacterial and chemical indicators. In general, changes in water quality in terms of bacterial and chemical indicators are localized and decay quickly over time. Experimental studies show that during the recreational period, significant increases in the upper soil horizons along the shores of water bodies are observed: chlorides (by 5-15 times), sodium (by 3-7 times), and mineral compounds of nitrogen and phosphorus (by 2-3 times). By the next recreational season, the chemical composition of soils in recreational areas is virtually restored and differs only slightly from control samples [27]. However, in suburban parks, which operate year-round, this process causes serious problems.

All anthropogenic impacts – whether they affect the lithosphere, atmosphere, soil (pedosphere) or urbanized environment – reach the hydrosphere through atmospheric precipitation, soil runoff, groundwater migration and other processes associated with the water cycle [26].

In large cities, particularly Yerevan, wastewater enters water supply systems, and its use to fill artificial reservoirs can lead to various health problems. In this regard, certain problems can arise from petroleum product discharges from car washes, the treatment of which has become an important task before discharge into the water supply.

The legislation of the Republic of Armenia permits the discharge of industrial wastewater into the centralized sewer system, provided that the centralized sewer system has sufficient capacity and the composition and characteristics of the wastewater comply with the requirements for industrial wastewater discharge into the sewer system established by the Water Code of the Republic of Armenia. If wastewater from industrial organizations may contain harmful pollutants, its discharge into the centralized sewer system is limited. In the event of non-compliance with the requirements for industrial wastewater discharge into the sewer system, organizations discharging industrial wastewater are required, at their own expense, to pre-treat it at local treatment facilities before discharging it into the centralized sewer system [28]. This requirement should also apply to car washes in recreational areas. Discharging waste containing oil components into small bodies of water can be extremely harmful to the aquatic ecosystems of suburban parks. To address this problem, it is necessary to develop and implement simple and inexpensive technologies for wastewater treatment at car washes.

The fundamental difference between urban reservoirs and watercourses and similar natural water bodies is that they are not part of a macroecosystem, but rather are part of a specific urban system. Urban systems are fundamentally different from natural ecosystems. They are dynamically developing natural-anthropogenic systems consisting of architectural and construction objects and transformed components of the natural environment. Urban systems are the habitats of people living in cities and are created specifically for them. Even the natural environmental elements (park areas, etc.) that remain in urbanized areas are intended primarily to create a favorable living environment for the urban population. As a rule, the true goal of

measures aimed at maintaining the natural elements of urban systems is not the restoration of natural communities within them, but the preservation of their recreational potential and video-ecological properties. For this purpose, for example, all parks are cleared of unwanted vegetation, wetlands are eliminated on the shores of lakes within urban development zones, etc. Thus, the structural and functional organization of urban systems is based on completely different principles than in natural ecosystems. [29].

Therefore, the natural course of self-cleaning and self-healing processes is impossible here.

A bioengineering technology for improving pond water quality is based on the self-purifying properties of natural hydroecosystems. The primary purification mechanisms are planktonic and benthic filter-feeding microorganisms and higher aquatic vegetation. It is recommended to stock the pond with higher aquatic vegetation, planktonic and benthic hydrobionts (filter-feeding organisms), and zooplankton. A balanced, interconnected ecosystem develops around aquatic vegetation. Aquatic vegetation can absorb phenols and petroleum products, and reduce water turbidity.

The water lily (Nymphaea) is recommended for use in artificial ponds. Found in freshwater in the foothills of the Lori and Shirak regions, it is a beautiful plant in the Armenian flora.[2] It is listed in the Red Book of the Republic of Armenia. The leaves are large, floating freely on the surface of the water. The flowers are bisexual, large, solitary, on long peduncles, white, and fragrant.

Fig. 7 The water lily (Nymphaea)

They open during the day and close and sink into the water after sunset. It blooms from late May until late autumn. The fruits are green, multi-seeded, berry-like. When ripe, the fruit falls to the bottom, rots, and the seeds rise to the surface of the water and are spread by waterfowl. It also reproduces vegetatively, by creeping rhizomes. The water lily has been acclimatized in the pond of the Yerevan Botanical Garden, where it grows, flowers, and bears fruit well. The flowers contain alkaloids and essential oils.

Oxygenating plants promote active oxygenation of the water and help establish ecological balance in the pond. Few of these species have decorative flowers. Their role is more interesting: oxygenating plants act as a green backdrop and maintain the pond's health. These include marsh grass, water buttercup, pondweed, water lily, turcha, hornwort, elodea, and others. They can float in the water or be rooted in the pond's bottom soil.

[2] https://econews.am/?p=7106&l=am

A.A. Ohanyan

PLACEMENT OF PLANTS IN COMBINATION WITH SCULPTURES NEAR WATER BODIES IN THE IMPROVEMENT OF SUBURBAN PARKS

A bioplateau is a unique "swamp," densely planted with plants, located in close proximity to the main body of water or integral to it.[3]

The primary function of this artificial shallow water is water filtration by plants. Water from the pond, passing through the bioplateau, is purified of impurities by the stems, leaves, and roots of the plants that fill it. Nitrates, phosphates, and heavy metals are also removed by microorganisms (the so-called biofilm) that inhabit the bioplateau.

Fig. 8 Example of a bioplato device

The resulting water is naturally purified and oxygenated, brimming with a variety of microorganisms. Water is supplied to the bioplateau by a pump that draws water from the bottom of the main pond (Fig. 9). A second pump may also be installed, collecting water from the pond's surface. The bioplateau can be positioned at a slight slope toward the pond, with a slightly higher water level to promote natural runoff.

Water can flow along a constructed channel like a stream or simply overflow the edge of the dividing wall between the "marsh" and the pond. This natural purification system begins to function fully in the third or fourth year, but the first results (the actual water purification) are noticeable within two weeks to a month after its installation. The bioplateau's surface area should be 30-50% of the pond's surface area. The bottom of the bioplateau is lined with plastic film, and crushed rock, pebbles, or gravel are used instead of soil for plants. This is necessary to stimulate the plants to absorb organic matter from the flowing (polluted) water and "feed" on it [30].

A bioplatform should be planted abundantly. The planting is typically done with shallow-water species that are tolerant of your climate. Dense planting will not only ensure high-quality purification but also provide shade for the water, preventing it from overheating. However, when creating a bioplatform, don't overplant it immediately: with proper arrangement, plants will grow quickly. The bioplato operates from May to October. At the end of the season, if possible, remove plant debris (leaves, stems).

[3] https://7dach.ru/Anastasia/chto-posadit-v-vodoeme-rasteniya-dlya-krasoty-i-ochistki-vody-267325.html

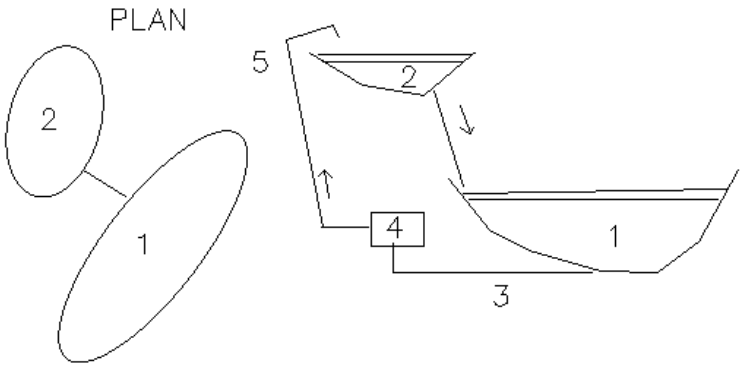

Fig. 9 Water supply scheme to the bioplateau using a pump

1-pond, 2-bioplateau, 3-water intake from the pond, 4-pump, 5-water supply pipeline to the bioplateau

If the bioplateau is placed high enough above the pond, water can be returned through the springboard, providing the pond with additional oxygen.

It's crucial to build high walls around the bioplateau to prevent water from overflowing away from the pond. Traditionally, a 50-cm-deep pit is dug (the walls must be insulated), which is then filled with 20-30 cm of rock. If the bioplateau is being created at a higher level, with a slope toward the pond or a waterfall, a pit is not dug, but walls are required along all sides not bordering the pond.

Tests of the "Grunt-PMM" cartridges show that by increasing the concentration of PMM in the soil, they can be used as a waterproofing material in water supply systems and in urban construction [31].

The results of our laboratory studies suggest that waterproofing of bioplato walls can be achieved using 7 cm thick cartridges, mixing «PMM» with soil in a proportion of 9 kg per square meter of surface area. In the case of sandy-clayey soils, the proportion of polymer-mineral material «PMM» can be reduced to 7.5 kg/m^2.

During pond operation, it is necessary to stop the flow of polluted surface water into the reservoir and regularly monitor the hydrochemical and hydrobiological parameters of the water. During winter, it is advisable to aerate the reservoir using specialized equipment. In the spring, if necessary, supplementary stocking with individual fish species and broodstock of forage invertebrates should be carried out.

Conclusion

1. Preventing rotting processes in standing water is one of the main problems of artificial reservoirs in suburban city parks. A bioengineering technology developed for the climatic conditions of Yerevan, based on the use of the self-purifying capacity of natural hydroecosystems, can improve the water quality in small reservoirs of suburban parks.
2. During pond operation, it is necessary to stop the flow of polluted surface water into the reservoir and regularly monitor the hydrochemical and hydrobiological parameters of the water.
3. The results of our laboratory studies suggest that waterproofing of bioplato walls can be achieved using 7 cm thick cartridges, mixing PMM with soil in a proportion of 9 kg per square meter of surface area. In the case of sandy-clayey soils, the proportion of polymer-mineral material "PMM" can be reduced to 7.5 kg/m^2.

References

1. Georgiev A. P., Shirokov V. A., Cherepanova N. S., Korkin S. V. Anthropogenic impact on aquatic ecosystems of the Republic of Karelia //Bulletin of the Astrakhan State Technical University. Series: Fisheries. 2021. No. 1. P. 14—23. DOI: 10.24143/2073-5529-2021-1-14-23
2. Goryunova S., Suzdaleva A. Small urban water bodies: environmental problems, solutions // «Balti: Palmarium Academic Publishing», 2017. – 116 p.
3. Suzdaleva A.L., Beznosov V.N., Goryunova S.V. Biological invasions in natural and technical systems // Bulletin of RUDN. Series "Ecology and Life Safety", 2015, No. 3. P.34-39.
4. Ostroumov S.A. Towards the general theory of ecosystem-dependent control of water quality. - Ecologica, 2009, vol. 16, No. 54, p. 25-32.
5. Ostroumov S. A. Self-purification" of water in nature //Ecology and life. 2005. No. 7. P. 42—46.
6. CR 11-102-97. Engineering and Environmental Surveys for Construction. Moscow: Gosstroy, 1997. - 105 p.
7. Krivitsky S.V., Kashperyuk A.P., and Kashperyuk P.I. Features of the formation of hydroecosystems of artificial reservoirs of recreational zones // Bulletin of MGSU, N4-2, 2010, pp. 163-169.
8. Cai, W., and Cowan, T. (2008). Evidence of Impacts from Rising Temperature on Inflows to the Murray-Darling Basin. Geophys. Res. Lett. 35, LO7701. Doi:10.1029/2008gl033390
9. UNFCCC (2015). Adoption of the Paris Agreement. Report No. FCCC/CP/2015/ L.9/Rev.1. Available at: http://unfccc.int/resource/docs/2015/cop21/eng/l09r01.
10. Avanesyan E.V. Some Problems on Enhancing the Efficiency of Water Utilization in a Climate Change in the Republics of Armenia and Artsakh // Bulletin Of High Technology, Stepanakert, N 2 (16) 2021, pp. 3-14.
11. Capon, Samantha & Stewart-Koster, Ben & Bunn, Stuart. (2021). Future of Freshwater Ecosystems in a 1.5°C Warmer World. Frontiers in Environmental Science. № 9. — P. 59—69. Doi: 10.3389/fenvs.2021.784642
12. Xia, X. H., Wu, Q., Mou, X. L., and Lai, Y. J. (2015). Potential Impacts of Climate Change on the Water Quality of Different Water Bodies. J. Env Inform. 25 (2), 85–98. Doi:10.3808/jei.201400263
13. Koutroulis, A. G., Papadimitriou, L. V., Grillakis, M. G., Tsanis, I. K., Wyser, K., and Betts, R. A. (2018). Freshwater Vulnerability under High End Climate Change. A Pan-European Assessment. Sci. Total Environ. 613-614, 271–286. Doi:10.1016/j.scitotenv.2017.09.074
14. World Meteorological Society (2021). United in Science 2021: A MultiOrganization High-Level Compilation of the Latest Climate Science Information. World Meteorological Society.

15. IPCC (2021). Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.
16. Capon, S. J., and Pettit, N. E. (2018). Turquoise Is the New green: Restoring and Enhancing Riparian Function in the Anthropocene. Ecol. Manag. Restor. 19, 44–53. Doi:10.1111/emr.12326
17. Prostranstvo drugimi slovami: francuzskie pojety HH veka ob obraze v iskusstve / Sost., per. B. Dubina. S(Pb), 2005.-304s.
18. Teodoronsky V.S. Objects of landscape architecture / V.S. Teodoronsky, I.O. Bogovaya //M: 2003. – 300 p.
19. Ohanyan, A.A. The Influence of the National Mentality on the Monumental Works of Sargis Baghdasaryan // Bulletin Of High Technology, Yerevan, N 1 (29) 2024.-72-81.
20. Ohanyan, A.A. Economic Factors in Establishing a Comfortable Urban Environment to Promote the Growth of Ecotourism // Bulletin Of High Technology, Yerevan, N 2 (30) 2024.-61-82.
21. Yuryeva, O. Yu. “The Role of Sculpture in Landscape Gardening: A Case Study of Small Architectural Forms in the Leningrad Region.”—“Current Issues of Monumental Art,” Proceedings of the International Scientific and Practical Conference / edited by D. O. Antipina, R. A. Bakhtiyarov, and S. N. Krylov. St. Petersburg, 2022.—134–143.
22. Sako from Lori—Tumanyan's Poem about Communication with Ghosts https://narine13e.livejournal.com/171996.html
23. Zhdanok D.N., Ovchinnikov A.A. Psychosis as stress causing post-traumatic personality changes // Journal of Neurology and Psychiatry named after S.S. Korsakov. 2019;119(2):125 128.
24. Art therapy in the prevention of depression in young people // https://rcmipp.tatarstan.ru/file/pub/pub_4453461.pdf
25. Kriger N.V. Landscape gardening art / N.V. Kriger, N.V. Fomina; Krasnoyarsk State Agrarian University. - Krasnoyarsk, 2021. - 376 p.
26. 12. Suzdaleva A.L., Goryunova S.V. Technogenesis and degradation of surface water bodies // M: OOO ID ENERGY, 2014. 456 p.
27. Lantsova I.V. The impact of recreational use on the water quality of the Ivankovskoye Reservoir // Bulletin of Peoples' Friendship University of Russia. series: ecology and life safety, N1, 2009, pp. 42-50.
28. . Resolution of the Government of the Republic of Armenia dated November 14, 2025 N1597-N "On establishing the requirements for the preliminary treatment of industrial wastewater".
29. Kalabekov A.L. Structural and functional organization and environmental monitoring of the urban system of a megalopolis // Abstract of a PhD thesis. M: Moscow State University, 2003. 42 p.
30. Plants for beauty and water purification //https://7dach.ru/Anastasia/chto-posadit-v-vodoeme-rasteniya-dlya-krasoty-i-ochistki-vody-267325.html

31. Vartanyan A.A., Kuprikov M.Yu., Ripetskiy A.V., Hayriyan G.L., Tokmajyan H.V. (2024) Development of Water-Retaining Cartridges With Polymer-Mineral Material //Bulletin of High Technology, Yerevan, 2024, N 4 (32), pp. 11-22. https://doi.org/10.56243/18294898-2024.4-11

References

1. Гориев А. П., Широков В. А., Черепанова Н. С., Коркин С. В. Антропогенное влияние на водные экосистемы республики карелия // Вестник Астраханского государственного технического университета. Серия: Рыбное хозяйство, 2021, № 1, с. 14—23. DOI: 10.24143/2073-5529-2021-1-14-23
2. Горюнова С., Суздалева А. Малые городские водные объекты: экологические проблемы, пути решения //«Balti: Palmarium Academic Publishing», 2017. – 116 с.
3. Суздалева А.Л., Безносов В.Н., Горюнова С.В. Биологические инвазии в природно-технических системах //Вестник РУДН. Серия «Экология и безопасность жизнедеятельности», 2015, № 3. С.34-39.
4. Остроумов С.А. К общей теории экосистемно-зависимого управления качеством воды. – Экологика, 2009, т. 16, № 54, с. 25-32.
5. Остроумов С.А. «Самоочищение» воды в природе//Экология и жизнь, 2005, № 7. С.42-46.
6. СП 11-102-97. Инженерно-экологические изыскания для строительства. М.: Госстрой, 1997. - 105 с.
7. Кривицкий С.В., Кашперюк А.П., and Кашперюк П.И.. Особенности формирования гидроэкосистемы искусственных водоемов рекреационных зон //Вестник МГСУ, N4-2, 2010, pp. 163-169.
8. Cai, W., and Cowan, T. (2008). Evidence of Impacts from Rising Temperature on Inflows to the Murray-Darling Basin. Geophys. Res. Lett. 35, LO7701. Doi:10.1029/2008gl033390
9. UNFCCC (2015). Adoption of the Paris Agreement. Report No. FCCC/CP/2015/ L.9/Rev.1. Available at: http://unfccc.int/resource/docs/2015/cop21/eng/l09r01.
10. Avanesyan E.V. Some Problems on Enhancing the Efficiency of Water Utilization in a Climate Change in the Republics of Armenia and Artsakh // Bulletin Of High Technology, Stepanakert, N 2 (16) 2021, pp. 3-14.
11. Capon, Samantha & Stewart-Koster, Ben & Bunn, Stuart. (2021). Future of Freshwater Ecosystems in a 1.5°C Warmer World. Frontiers in Environmental Science. № 9. — P. 59—69. Doi: 10.3389/fenvs.2021.784642
12. Xia, X. H., Wu, Q., Mou, X. L., and Lai, Y. J. (2015). Potential Impacts of Climate Change on the Water Quality of Different Water Bodies. J. Env Inform. 25 (2), 85–98. Doi:10.3808/jei.201400263
13. Koutroulis, A. G., Papadimitriou, L. V., Grillakis, M. G., Tsanis, I. K., Wyser, K., and Betts, R. A. (2018). Freshwater Vulnerability under High End Climate Change. A Pan-European Assessment. Sci. Total Environ. 613-614, 271–286. Doi:10.1016/j.scitotenv.2017.09.074

14. World Meteorological Society (2021). United in Science 2021: A MultiOrganization High-Level Compilation of the Latest Climate Science Information. World Meteorological Society.
15. IPCC (2021). Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.
16. Capon, S. J., and Pettit, N. E. (2018). Turquoise Is the New green: Restoring and Enhancing Riparian Function in the Anthropocene. Ecol. Manag. Restor. 19, 44–53. Doi:10.1111/emr.12326
17. Prostranstvo drugimi slovami: francuzskie pojety HH veka ob obraze v iskusstve / Sost., per. B. Dubina. S(Pb), 2005.-304s.
18. Теодоронский В.С. Объекты ландшафтной архитектуры / В. С. Теодоронский, И. О. Боговая. – М: «МГУЛ», 2003. – 300 с.
19. Ohanyan, A.A. The Influence of the National Mentality on the Monumental Works of Sargis Baghdasaryan // Bulletin Of High Technology, Yerevan, N 1 (29) 2024.-72-81.
20. Ohanyan, A.A. Economic Factors in Establishing a Comfortable Urban Environment to Promote the Growth of Ecotourism // Bulletin Of High Technology, Yerevan, N 2 (30) 2024.-61-82.
21. Юрьева О.Ю. Роль скульптуры в садово-парковом искусстве на примере малых архитектурных форм Ленинградской области.-«Актуальные проблемы монументального искусства», сборник научных трудов международной научно-практической конференции / под редакцией Д.О. Антипиной, Р.А. Бахтиярова, С.Н. Крылова. Санкт-Петербург, 2022.-134-143.
22. Сако из Лори—поэма Туманяна про общение с призраками https://narine13e.livejournal.com/171996.html
23. Жданок Д.Н., Овчинников А.А. Психоз как стресс, вызывающий посттравматические изменения личности //Журнал неврологии и психиатрии им. С.С. Корсакова. 2019;119(2):125-128.
24. Арт-терапия в профилактике депрессии у молодежи https://rcmipp.tatarstan.ru/file/pub/pub_4453461.pdf
25. Кригер Н. В. Садово-парковое искусство / Н. В. Кригер, Н. В. Фомина; Красноярский государственный аграрный университет.– Красноярск, 2021, 376 с.
26. Суздалева А.Л., Горюнова С.В. Техногенез и деградация поверхностных водных объектов //М: «ООО ИД ЭНЕРГИЯ» ,2014. 456 с.
27. Ланцова И.В. Влияние рекреационного использования на качество воды Иваньковского водохранилища //Вестник российского университета дружбы народов. серия: экология и безопасность жизнедеятельности, N1, 2009, pp. 42-50.
28. Հայաստանի Հանրապետության կառավարության 2025 թվականի նոյեմբերի 14-ի N1597-Ն որոշումը «Արդյունաբերական կեղտաջրերի նախնական մաքրման պահանջները սահմանելու մասին»:

29. КалабековА.Л. Структурно-функциональная организация и экологический мониторинг урбосистемы мегаполиса // Автореф. дис. ... докт. биол наук. М: МГУ, 2003. 42 с.
30. Растения для красоты и очистки воды //https://7dach.ru/Anastasia/chto-posadit-v-vodoeme-rasteniya-dlya-krasoty-i-ochistki-vody-267325.html
31. Vartanyan A.A., Kuprikov M.Yu., Ripetskiy A.V., Hayriyan G.L., Tokmajyan H.V. (2024) Development of Water-Retaining Cartridges With Polymer-Mineral Material //Bulletin of High Technology, Yerevan, 2024, N 4 (32), pp. 11-22. https://doi.org/10.56243/18294898-2024.4-11

ՋՐԱՎԱԶԱՆՆԵՐԻ ՄՈՏ ՔԱՆԴԱԿՆԵՐԻ ՀԵՏ ՀԱՄԱԽՄԲՎԱԾ ԲՈՒՅՍԵՐԻ ՏԵՂԱԲԱՇԽՈՒՄԸ ՔԱՂԱՔԱՄԵՐՁ ԶԲՈՍԱՅԳԻՆԵՐԻ ԲԱՐԵԿԱՐԳՄԱՆ ԺԱՄԱՆԱԿ

Ա.Ա. Օհանյան
Հայաստանի ազգային պոլիտեխնիկական համալսարան

Ջրային համակարգերը կարևոր դեր են խաղում քաղաքակրթության զարգացման գործում և ունեն զգալի սոցիալ-տնտեսական նշանակություն: Քաղցրահամ ջրերի էկոհամակարգերը ապահովում են կենսական ծառայությունների լայն շրջանակ, որոնք օգտակար են համայնքների համար:

Ժամանակակից քաղաքը տնտեսական և սոցիալական կյանքի կենտրոնն է: Այն ոչ միայն մարդկանց բնակության վայր է, այլև տարբեր գործունեությունների կենտրոն (հանգստի, աշխատանքի և այլն): Հանրային տարածքները կարևոր դեր են խաղում անհատական և սոցիալական բարեկեցության ապահովման գործում, որտեղ տարբեր ոչ նյութական արժեքների կարևորությունն առավել շոշափելի է դառնում: Այս համատեքստում, փոքր լճակներով քաղաքամերձ զբոսայգիները կարևոր դեր են խաղում գրավիչ միջավայր պահպանելու գործում: Միևնույն ժամանակ, ջրային մարմինները ենթարկվում են զգալի անթրոպոգեն ազդեցության և հաճախ գտնվում են անմխիթար վիճակում:

Ներկայացված հոդվածում քննարկում են փոքր լճակներով քաղաքամերձ զբոսայգիների ստեղծման և պահպանման հետ կապված մի շարք հարցեր:

Բանալի բառեր. ռեկրեացիա, ջուր, քաղաքային միջավայր, լճակ, կենսասարահարթ:

A.A. Ohanyan

PLACEMENT OF PLANTS IN COMBINATION WITH SCULPTURES NEAR WATER BODIES IN THE IMPROVEMENT OF SUBURBAN PARKS

РАЗМЕЩЕНИЕ РАСТЕНИЙ В СОЧЕТАНИИ СО СКУЛЬПТУРАМИ ВБЛИЗИ ВОДОЕМОВ ПРИ БЛАГОУСТРОЙСТВЕ ПРИГОРОДНЫХ ПАРКОВ

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Водные системы играют важнейшую роль в развитии цивилизации и имеют важное социально-экономическое значение. Пресноводные экосистемы предоставляют широкий спектр жизненно важных услуг, приносящих пользу сообществам.

Современный город является эпицентром экономической и социальной жизни. Это не только место проживания людей, но и центр различных видов деятельности (досуга, работы и т. д.). Общественные пространства играют ключевую роль в обеспечении индивидуального и социального благополучия — места коллективной жизни, где выражение различных нематериальных ценностей становится наиболее ощутимым. В этом контексте пригородные парки с водоемами играют решающую роль в поддержании привлекательной окружающей среды. Однако они часто подвергаются значительному антропогенному воздействию и находятся в состоянии деградации.

В данной статье рассматриваются некоторые вопросы, связанные с созданием и содержанием пригородных парков с водоемами.

Ключевые слова: рекреация, вода, городская среда, пруд, биоплато.

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