



LAKE BALATON  
DEVELOPMENT COUNCIL

# 19TH WORLD LAKE CONFERENCE

**BALATONFÜRED, HUNGARY**

**NOVEMBER 7-9, 2023**



**BOOK OF**

**ABSTRACTS**



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## BOOK OF ABSTRACTS

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**ORAL  
PRESENTATIONS**

## TITLE

**I LEARNED FROM EXPERIENCE. ABOUT THE SUSTAINABLE USE OF LAKE BIWA AS A LOCAL RESIDENT.**

## AUTHOR(S)

Takako Abe, Mana Kosugi, Oka Miyajima

## AFFILIATION(S)

Citizens' groups (Otsu, Shiga)

Sustainable use of Lake Biwa.

We live in Shiga Prefecture, where Lake Biwa is located, and have been engaged in various Hands-on activity.

1. Used a canoe to go out on the lake to sample water, observed plankton in the water, conduct water quality surveys, observed reeds growing on the lakeshore, and observe creatures living in the reed zone.
2. We interacted with people who continue to observe waterfowl that fly from Siberia in winter, heard about current waterfowl problems, and observed waterfowl.
3. We picked up garbage that accumulated on the lake shore.
4. We got on a fisherman's boat and experienced nigorobuna fishing.
5. We, the members of the group, were put on a ship of the Ministry of Land, Infrastructure, Transport and Tourism and learned about the contents and situation that are measured on a daily basis. I also experienced the survey method.
6. Observing living creatures in the rivers and rice fields leading to Lake Biwa, and researching plants along the riverbanks.

Through my experiences, I learned that Lake Biwa can be used in a variety of ways, such as securing food for survival, sightseeing and play for enjoyment, and learning about living organisms through observation. For us, they are all things that we have learned through experience, and they are also pleasant memories.

Next, we(junior high, high school, and college students) thought about what we can do to make Lake Biwa sustainable.

1. We don't make or throw away garbage.
2. Learn deeply and broadly about Lake Biwa.
3. Make friends. The key words are transmission and exchange.

## TITLE

**THE ROLE OF LAKE MORPHOLOGY IN SHAPING BENTHIC DIATOM COMMUNITIES IN SMALL FOREST PONDS**

## AUTHOR(S)

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Small lakes are among the most endangered ecosystems globally. They require important protection due to their disproportionately high biodiversity compared to their size. The present study aimed to identify the primary drivers, specifically the role of morphological factors, shaping benthic diatom communities in forest pond systems in temperate regions. Both classic (species-based methods and diversity indices) and innovative (trait-based methods and functional diversity indices) approaches of diatom ecology were used. As a result, we analyzed the impacts of environmental (temperature, conductivity, color, shading, pH, nutrient forms, anions) and morphological (surface area, depth) characteristics on 70 temperate forest ponds located across two areas of Hungary. Specifically, we examined the effects on community composition (both species- and trait-based) and diversity (traditional and functional) of their benthic diatom populations. Both environmental factors like nutrients and conductivity as well as morphological characteristics like surface area and depth influenced the diatom communities. Environmental variables primarily impacted species composition and traditional diversity metrics, while morphological features had a stronger influence on trait composition and functional diversity by selecting species based on their trait. The results underline the complex interaction between environmental factors and lake morphology in determining the benthic diatom communities, emphasizing the need for diverse methods to understand the ecology and functioning of these unique aquatic ecosystems.

## TITLE

## FUNCTIONAL DIVERSITY AND COMPARATIVE ANALYSES OF NON-MARINE OSTRACODA (CRUSTACEA) BETWEEN LENTIC AND LOTIC AQUATIC HABITATS (AMASYA, TÜRKIYE)

## AUTHOR(S)

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In order to compare species assemblages and diversity of nonmarine ostracods between lotic and lentic habitats, 80 different aquatic sites were randomly sampled during May of 2022 in the Amasya province (Türkiye). We found 28 taxa (18 live, 10 subfossil taxa) from 59 of 80 sites. Total of 25 taxa were new for the province. *Ilyocypris bradyi*, *Heterocypris incongruens*, and *Prionocypris zenkeri* were the most frequently occurring species. Ecological tolerance levels of the species with cosmopolitan characteristics were relatively higher than rare or non-cosmopolitan species. Individual comparison of t-test with unequal variances displayed that the troughs showed significant differences with dams ( $p = 0.02$ ) and ponds ( $p = 0.01$ ). Pair-wise comparative analyses amid two types of habitats showed that mean values of ostracod abundances were significantly different between lentic (dam-pond) and lotic (stream-canal-trough) ( $p < 0.05$ ) habitats, indicating that lentic habitats cover more species numbers and abundance than lotic habitats. Correspondence analyses revealed that water temperature and pH were found to be the most effective environmental variables ( $p < 0.05$ ) on species distribution when the numbers of species exhibited positive and negative relationships with chloride and sulphate, respectively. The functional richness values indicated that species in lentic habitats were commonly found with swimming setae on the second antennae. This was the opposite in species found in lotic habitats with short or reduced setae. In comparison, cosmopolitan species were common in artificial habitats (e.g., troughs) with relatively lower optimum estimates but higher tolerances. This may imply the fact that cosmopolitan species can increase their survival chances in variety of habitats. Thus, results suggest that ostracod diversity can be proportionally higher in lentic habitats than the lotic habitats. The functional evenness values exposed that the functional distance between species in dams and troughs was more regular compared to streams. These results suggest that functional diversity indices can be used to evaluate the function and indicator potential of ostracod species in aquatic systems.

## TITLE

## COMPREHENSIVE RESTORATION OF KARTUZY LAKES COMPLEX (KASHUBIAN LAKELAND, NORTHERN POLAND)

## AUTHOR(S)

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Deterioration of surface water quality is a serious problem throughout the world. Lakes located in urban areas are a very valuable part of the landscape, but they are under high anthropopressure, due to the proximity of human settlements. Changes in direct catchment use and pollution by raw wastewater very often have led to serious disruption of such lake ecosystems. The implementation of protective measures in the catchment and direct technical interventions in the lake bowl is the only way to improve the water quality of those valuable ecosystems.

The Kartuzy Lakes complex consists of four urban lakes in Kartuzy City (Poland). They are hydrologically connected by the Klasztorza Struga stream, forming the lake-river system. Two of them (Mielenko Lake and Karczemne Lake) are shallow, non-stratified lakes, while Klasztorza Mała and Klasztorza Duża lakes are deeper and stratified lakes. The protective measures (modernization of the sewerage system and cut-off raw wastewater inflows) were implemented before beginning technical actions performed in the lakes' bowls. The phosphorus inactivation using iron and aluminum coagulants (PAX 18 and PIX 111) was applied on three lakes in the years 2020-2022 (Mielenko, Klasztorza Mała and Klasztorza Duża). The most polluted shallow Karczemne Lake was subjected to bottom sediment dredging (2020-2022) and in 2023 last treatment using the P inactivation method will be completed. Biomanipulation of fish species structure also was applied on every lake as the supporting method.

Sediment removed from Karczemne Lake was treated through a special technological line constructed in the Kartuzy Wastewater Treatment Plant. The final product of the treatment was suitable for agricultural use.

The restoration of Kartuzy Lakes was financed from EU funds (Operational Programme "Infrastructure and Environment") and it is the biggest lake restoration project in Poland. Lake water and sediment monitoring results showed, that applied restoration methods improved the water quality of Kartuzy Lakes. The results of treatment will be monitored in the next years. An experience from the project realization shows, that the close cooperation of scientists and stakeholders is good practice in lake management, as well as the use of comprehensive restoration measures allows to obtain the improvement of lake water quality.



## TITLE

**PIT LAKES AT THE TOKAJ WINE REGION: PAST, PRESENT, AND FUTURE**

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The Tokaj Wine Region has a similarly long history and tradition of surface mining like the viticulture and winemaking. For centuries, the Zemplén Hills, which are part of the wine region, were dominated by the mining of precious ores and minerals, which added by quarrying. Since the mid-1960s, the demand of mined rock has increased dramatically, both through the development of quarries that had been in operation for centuries and the opening of new large-capacity quarries. The abandonment of mining activities was not followed by rehabilitation or alternative use. The process has resulted in the creation of a number of pit lakes in the Tokaj Wine Region. Mine pit lakes are created, intentionally or otherwise, when open cut mine voids fill with water after mining and dewatering cease.

However, depending upon certain characteristics pit lakes often also present opportunities to provide significant regional benefit and even offset the environmental costs of mining by creating new end uses. These opportunities are widely dependent on water quality, slope stability, and safety issues, etc. Unfortunately, some pit lakes have continued to be abandoned without repurposing for an end use. Many end uses have been realized: passive and active recreation, nature conservation, fishery and aquaculture, drinking and industrial water storage, greenhouse carbon fixation, flood protection and waterway remediation, disposal of mine and other waste, mine water treatment and containment, and education and research.

In the Tokaj Wine Region, there are currently only two good examples of the alternative use of pit lakes. One of the mines is located near Tarcal in the "Citrom" mine, while the other is located near Sárospatak on the Megyer hill under the name "Megyer-hegyi Tengersizem". The last decade has seen the development of pit-lakes-related investments, with tangible results. Within tourism, these two destinations have become dominant in the fields of wine tourism, religious tourism and recreational tourism.

We present their past, present and future, taking sustainable development into account. The two examples presented may reflect opportunities to implement good practices for other wine regions with pit-lakes.

## TITLE

**PALAEOLIMNOLOGICAL RESEARCH OF BALATON BASED ON CHIRONOMIDAE REMAINS: PRELIMINARY RESULTS**

## AUTHOR(S)

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Lake Balaton represents a special water body type in Hungary and Europe, it is also at the centre of social interest. Frequent cyanobacteria blooms of the last decade associated with calm, warm summer conditions had on the one hand negative consequences for tourism, and on the other hand, these events are also warning signals that the lake has moved out from its safe operating space according to Dearing et al. (2014) concept. To understand these warning signals, and to define the safe operating space of the lake ecosystems, knowledge of its macroinvertebrate fauna and its changes during the last 200 years are of prime importance. In this study we use paleolimnological methods to reconstruct ecosystem changes in Balaton through the study of chironomid (non-biting midge) larval assemblages. We took 40-45 cm long sediment cores from the Siófok and Keszthely basins in 2023, then we cut the cores into 1 cm slices, and used 2 cm<sup>3</sup> sediment from each layer for chironomid analysis. From the Siófok basin a total of 1857 head capsules were identified with 12 morphotypes from 2 subfamilies (Chironominae and Tanypodinae). The most frequent taxon was *Procladius* sp., but *Microchironomus* sp. and *Stempellina* sp. were also present in larger number. From the Keszthely basin 1569 chironomid head capsules were identified, belonging to 20 taxa from 3 subfamilies (Chironominae, Orthocladiinae and Tanypodinae). The most common taxa were *Procladius* sp., *Stempellina* sp., *Chironomus plumosus*-type. Cluster analysis divided the chironomid assemblages into 2 significant zones in both samples, zone 2 was divided into 2 subzones. Comparing this with previous research from the Szemes basin, supplemented with <sup>210</sup>Pb/<sup>137</sup>Cs based age-depth modelling, we conclude that there have been significant changes in the water quality of the lake in the last one and a half century. Although there are some differences between the Keszthely basin and the other two basins. For example, the number of *Stempellina* sp. decreased in the Szemes and Siófok basins at the beginning of the 20<sup>th</sup> century (between 1920-1930), but the relative frequency of *Stempellina* sp. did not decrease in the Keszthely basin as significantly as in the other two basins. *Chironomus plumosus*-type become dominant between 1920 and 1930 in all three sub-basins, which indicates an abrupt increase in the trophic level of Lake Balaton shortly after 1920. This was a critical time in the life of the lake, with an unprecedented rate of change in its macroinvertebrate fauna, and irreversible changes most likely connected to the population growth and the wave of construction of holiday homes without wastewater networks that started after the Trianon. This research is funded by NKFIH National Multidisciplinary Laboratory for Climate Change (RRF-2.3.1.-21-2022-00014)

## TITLE

**CONSERVATION AND RESTORATION OF LAKES AND WETLANDS - THE ASIAN PERSPECTIVE**

## AUTHOR(S)

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India is one of the 13 countries working in the IKI Living Lakes Biodiversity & Climate Project. This presentation will present in more details the work and achievement of NEWS, the local partner in India where the project sites cover communities in the eco-sensitive zone (ESZ) around the Deepor Beel wildlife sanctuary in Assam. The focus will be on the practical implementation of the Frontrunner Initiative and how it benefits the local community.

**Background**

The Deepor Beel is a Ramsar site, an inland wetland ecosystem of high genetic and ecological diversity in the state of Assam, India. The area adjacent to Bay of Bengal, is prone to frequent and severe storms and cyclones and ingression of saline water in the agricultural land and underground aquifers, making the area very vulnerable to climate-induced disasters. Tourism in Deepor Beel is drastically growing but waste disposal systems are lacking and principles of reuse and recycle are not practised. Therefore, litter is increasing and people have no option than burn waste in the household cook stoves.

**Solution**

To counter these challenges, NEWS is developing a homestay tourism model, based on a zero-waste principle, managed by rural community that will impact the social, economic and ecological context of the local population structure, transform the types of occupation, change values, build on the traditional lifestyle and modify consumption and waste patterns. The capacity development and implementation for biodiversity-friendly agriculture, sustainable water use will ensure quality, nutritious food for tourists as well as protect and sustain life on land and water. The model will secure women's avenues for income generation and involve them in mainstream development, while managing their house-hold chores through a shared approach. It will also provide an opportunity to promote sustainable community development by fostering gender equity, all based on the long term experience of the implementing partner.

## TITLE

**SPATIOTEMPORAL VARIABILITY ANALYSIS OF SURFACE WATER TEMPERATURE AND WATER QUALITY PARAMETERS IN LAKE TANA, ETHIOPIA**

## AUTHOR(S)

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Lake Tana, Ethiopia's largest and water hyacinth (*E. crassipes*) infested lake, provides critical economic, social, and ecological benefits, but human activities and climate change threaten its surface temperature and water quality. Understanding the spatiotemporal variability of surface water temperature and water quality parameters is critical for managing this vital resource. However, limited research has been conducted on this topic in Lake Tana. This study aimed to investigate the spatiotemporal variability of lake surface temperature (LSWT) and water quality parameters, such as turbidity and chlorophyll-a (Chl-a). The study used MODIS land/lake surface temperature (LSWT) data (2001-2022), Sentinel 2 Normalized Difference Chlorophyll Index (NDCI), and Normalized Difference Turbidity Index (NDTI) (2016-2022), NASA's Prediction of Worldwide Energy Resources (NASA/POWER) near- surface air temperature data (2001-2021), and in-situ water quality data. To analyze trends, the study employed pixel-based linear regression, Modified Mann-Kendall trend test, Innovative Trend Analysis (ITA), and Sen's slope estimator. Results showed a strong positive correlation ( $r=0.9$ ) between MODIS LSWT and in-situ water temperature, with reasonable errors (RMSE=1.6°C, MAE=1.48°C, MBE=-1.48°C, MAPE=6.25%), indicating the good agreement between the two data. Likewise, a strong positive correlation was observed between in-situ water turbidity and NDTI ( $r=0.92$ ) and between in-situ Chl-a and NDCI ( $r=0.84$ ), suggesting the applicability of these indices for estimating turbidity and Chl-a levels in Lake Tana. LSWT showed significant spatial and temporal variability across the lake. The southern, eastern, and southwestern parts experienced higher LSWTs, while the central and northern regions exhibited relatively lower LSWTs. Increasing trends of LSWT were observed in the northeastern, northwestern, and southwestern regions while decreasing trends were observed in the western, southern, and central parts of the lake. The LSWT trend decreased significantly in autumn, spring, and summer at cooling rates of  $0.013^{\circ}\text{C yr}^{-1}$ ,  $0.012^{\circ}\text{C yr}^{-1}$ , and  $0.016^{\circ}\text{C yr}^{-1}$  (2001-2022,  $P<0.05$ ), respectively. However, the LSWT trend increased insignificantly in winter at a rate of  $0.001^{\circ}\text{C yr}^{-1}$ . The spatial mean annual LSWT also decreased significantly at a cooling rate of  $0.12^{\circ}\text{C yr}^{-1}$  (2001-2022,  $P<0.05$ ). Water quality parameters showed significant spatial and temporal variability over the lake, with higher turbidity and Chl-a concentrations in the eastern, northeastern, northwestern, and southwestern regions, and lower values in the central and western regions during all seasons. Turbidity levels ranged from 1.5 to 81 NTU, and chlorophyll-a values ranged from 10.5 to 349  $\mu\text{g/L}$  in June 2023. NDTI exhibited a downward trend in all seasons (2016-2023), but the decrease rate was not significant during spring ( $P<0.05$ ). Likewise, the NDCI trend significantly decreased in spring and summer and insignificantly increased in autumn and winter. LSWT was positively correlated with NDTI and NDCI in all seasons with varying strengths. Furthermore, the study reported a positive correlation between LSWT and near-surface air temperature across all seasons, with the highest correlation in summer ( $r=0.68$ ) and the lowest in winter ( $r=0.25$ ). Overall, Lake Tana's water quality improved from 2016 to 2023, possibly due to the expansion of water hyacinths and Illinois pondweed along the shoreline. These findings will provide valuable information for water resource managers and relevant stakeholders to develop short and long-term management plans for preserving the lake environment.

## TITLE

**TECHNOLOGICAL INNOVATIONS TOWARDS LAKE MAINTENANCE (IN INDIA)**

## AUTHOR(S)

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This paper is a review of the technological innovations carried out towards lake cleaning and restoration in India in the recent times. The study is based on literature review of the technologies and secondary data collection besides substantiating each approach with a case study example. The study is done to take a cognizance of the tools and techniques that are in practice to draw patterns on the nuances of the approach, their relationship with the bio-physical environment of the lake, acceptance and affordability by the local officials and people, sustainability of the lake, etc. Twelve techniques are identified namely, Nualgi Technology, Purification Islands, Pilot Clean-up System, Accelerated Anaerobic Composting, Decentralized Treatment System, PHYTORID Method, Aquatic Weed Harvesting Machine, FloBoT, Hydrodynamic Cavitation, IBM's IOT & AI Technology, Continuous Laminar Flow Inversion & Oxygenation, and Remote Operated Boat from IOCI. Each technique is described briefly based on what, when, who, where, and why followed by informing its case study application. We found that the selection of technology for lake cleaning is attributed to the bio-physical characteristics of the lake like location, size, pollution level, budget, etc. Besides, the knowledge and network of the official or the person initiating the activity also influence the selection. The key learning is that the lake cleaning is embedded in the concept of restoration, conservation, preservation and most popularly development in which the visual cleanliness is considered as a step towards lake sustainability.

## TITLE

**PATTERN OF LAKE REJUVENATION IN INDIA**

## AUTHOR(S)

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W forW Foundation

The term 'Lake' is defined as distinct water bodies that are either humanly constructed or artificial & transient wet lands. The social-technically modified structure with expected natural ecosystem makes it difficult to define lake more precisely than calling it as complex socially-ecologically engineered ecosystem. In the absence of any acceptable technical definition these are conventionally & generically referred as 'lakes'. India with its typical characteristic of tropical landscape is flourished with water bodies such as, reservoirs, tanks, ponds, wetlands, many of which are referred as lakes. A significant attribute that distinguishes lakes is that the humanly constructed water bodies such as, ponds & tanks are historical while large reservoirs have been built very recently. Then there are large shallow lakes as wetlands of which many are now designated as Ramsar sites. While the lakes are dear to everyone and appropriated to the maximum resulting in severe challenges of governance, degradation, and even extinction.

The main causes of lake degradation from pollution are identified as, nutrients of municipal/ domestic and industrial wastewater discharge into the lakes besides the seasonal rainwater discharge and continuous solid waste disposal into the lake. In past few years significant number of initiatives are taken up across India by responsible citizens, community & concerned organizations that have helped in reducing degradation of lake to some extent. Our desk study is on documenting the lake rejuvenation efforts undertaken by various stakeholders across India. The objective of the study is to come up with a compilation of novel and innovative social-ecological-technological approaches besides drawing patterns from the lake problems and the lake rejuvenation approaches in order to better understand the complex social-ecological-technological system. Twenty-five lake rejuvenation efforts are documented from across the country. The extents of efforts, both top down and bottom-up approaches, are evident in which local stakeholders have risen up to fulfil their own needs by doing meaningful and innovative rejuvenation of lakes. Though distinct stakeholders have acted differently, a pattern observed is that all revival efforts are aimed towards ecological revival of the water bodies. In the documenting process, there is also a genuine effort to connect to the community of the lake warriors to understand from them the social-ecological-technological opportunities and challenges under which certain approach was adapted. In addition, explore with them the possibility of upscaling the rejuvenation efforts.

## TITLE

## EXPERIENCE OF THE FLOATING SCHOOL AS AN ENVIRONMENTAL EDUCATION STRATEGY FOR PRIMARY SCHOOL CHILDREN IN THE CITY OF MANAGUA, NICARAGUA

## AUTHOR(S)

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Nicaragua is located in Central America, has the largest lakes in the region, one of them is Lake Managua located at the foot of Managua city, capital of Nicaragua. It is an endorheic lake of 1000km<sup>2</sup> with an average depth of 7 meters. For decades Managua city discharged industrial pollutants and sewage without treatment. This contamination caused an unpleasant odor, causing in citizens a bad perception of the lake as dirty and polluted.

In 2007 the Nicaraguan government and Managua City Hall decided to improve condition of Lake Managua. In 2009 the wastewater treatment plant was built with a treatment capacity of 70% of city. To solve the leaching contamination problem generated at the "La Chureca" dump located along the lake, a landfill was built in 2012. As a consequence of above mentioned projects, the lake condition has been improved and the tourist development like ports and pier on the coastal area of the lake became possible.

Despite these advances, the lake continues to receive sediments, agrochemicals and waste caused by the bad attitude of citizens who pour sewage and solid waste into the rainwater canals that cross the city and discharge into the lake. Therefore, an integral basin management plan is needed to enable its recovery.

In the search for strategies, JICA in Nicaragua learned about the experience of Lake Biwa in Japan and inspired by it, created Biwako Task Force.

Initially, we established contact with ILEC experts who, through webinars, shared with more than 70 Nicaraguan officials the experience of recovery of Lake Biwa.

In January of this year, 2 Nicaraguan officials participated in a JICA course given by ILEC on integrated watershed management. With this and other actions, JICA hopes to develop capacities for Nicaraguans to lead comprehensive plans for the protection of our lake.

One of the emblematic activities that was introduced since 2021 is the floating school that had the support of Shiga Prefecture.

Thanks to the knowledge acquired by an ex-participant in a JICA training course, it was possible for the Municipality of Managua and JICA to successfully replicate the Japanese experience, to generate in children a meaningful experience to awake a love for the preservation of the lake. It started with 2 schools near Lake Managua, and is currently being implemented in 8 schools, with plans to integrate a total of 16 schools by 2025.

In the Nicaraguan experience, children are taken to a school day on a ferry (boat) while navigating the waters of the lake. Emphasis is placed on experiments demonstrating which activities pollute the lake and how they should be avoided. Nica Floating School goes beyond the water, also teaching in its education centers the proper management of waste.

The implementation of floating school in Nicaragua has been possible thanks to the valuable support of Shiga Prefecture and Floating School.

With strategies like this, we expect to transform the attitude and behavior of this generation, to promote sustainable development and a mutual coexistence between Managua citizens and its Lake.

## TITLE

## THE FLOATING HERITAGE OF SHALLOW LAKES - ISSUES OF REGENERATIVE SUSTAINABILITY

## AUTHOR(S)

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The floating heritage of lakes, which constitute more than 90% of our freshwater resources, includes a wide range of watercrafts such as small rowboats, speedboats, fishing vessels, freighters, dredgers, maintenance and research vessels, reed-cutting boats, sailing and passenger boats, shipyards, ports and piers, certain bridges (such as opening or swing bridges), the knowledge and skills of boat construction, the traditions of fishing and sailing competitions. This tangible and intangible heritage-complex represents a great value which must be preserved and used sustainably taking into consideration the vast changes regarding the use of lakes in the second half of the 20<sup>th</sup> century, when the rapid increase of multifunctional tourism (bathing, water sports, fishing), large-scale agriculture and coastal settlement developments became an increasing environmental load on the lakes. This is particularly pronounced in case of shallow lakes, which are extremely sensitive for pollution, nutrient discharge, water level fluctuations and ecosystem fragmentation. The built environment in the coastal areas affects the lake's biota, but the extent of the assumed additional burden and its impact processes cannot be predicted at this stage and will depend largely on the behaviour of local authorities and the individuals who live and spend their leisure time there. It is, however, safe to say that the lake's capacity to tolerate and adapt to the expected use of ecosystem services is limited. Furthermore, all these adverse impacts are enhanced by climate change, when loss of habitats and biodiversity, the appearance and the spread of invasive species may cause irreversible damage to valuable ecosystems. From the viewpoint of heritage conservation, which is defined as preservation, development, and sustainable use from an evolutionary perspective, we focus on the following issues:

1. the impact of old-fashioned, fossil fuel-based propulsion systems of traditional watercrafts on the ecosystems of shallow lakes,
2. the environmental impact of maintenance of watercrafts and emissions from shipyards,
3. measuring the ecological sensitivity of shallow lakes in terms of the accumulated impact of pollution, excessive water consumption and climate change,
4. erosion control measures along the lake's shoreline to prevent sedimentation and habitat degradation caused by wave action and human activities,
5. the compatibility of heritage originality and conversion of watercrafts to green operation by replacing the old engines with eco-friendly alternatives,
6. ecosystem fragmentation and habitat loss in the coastal areas attributed to grey infrastructure development linked to navigation and tourism,
7. impact of water level fluctuations of shallow lakes on waterways, the ecology of littoral zones, the biodiversity, and lake tourism
8. the floating heritage as a tourism product, destination development, and the carrying capacity of lake ecosystems,
9. good and bad practices regarding the conservation of the floating heritage and use of lake-ecosystem services,
10. the floating heritage as a tool for edutainment - innovative methods and gamification in formal and informal education

The regenerative conservation of the floating heritage of shallow lakes is an environmental, technological, cultural, economic, and social challenge, which can be handled by careful planning of development strategies, appropriate evaluation of the cultural values represented by this heritage, and the assessment and monitoring of the ecological, economic, and social carrying capacity of lake ecosystems.

## TITLE

**NUTRIENT BALANCE OF ANGLING-ORIENTED FISHERIES MANAGEMENT IN LAKE BALATON (HUNGARY)**

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Recreational fishing and the associated activities may have important effects on the nutrient dynamics of several freshwater ecosystems. Fish removal by anglers results in nutrient efflux from these habitats, while fish stocking and ground-baiting may represent anthropogenic external nutrient loading. The aims of our study were to estimate the annual nutrient balance of recreational fishing in the largest lake of Central-Europe (Lake Balaton, Hungary), and relate the nutrient loading from this source to the total external load received by the lake. Our results show that net fish removal (the difference between the removed and stocked fish biomass) returned to land on average  $3.1 \pm 0.3$  tonnes of phosphorus (P) and  $10.2 \pm 1.1$  tonnes of nitrogen (N) annually from Lake Balaton during the last couple years. By taking into account the N and P loads from ground-baits, the net balance of recreational fishing was  $+19.3$  tonnes N year<sup>-1</sup> and  $+5.2$  tonnes P year<sup>-1</sup>, which values are equivalent to 0.7% and 3.2% of the estimated total annual N and P loads, respectively. Thus, the nutrient balance of angling-oriented fisheries management showed a surplus in Lake Balaton, i.e., it represented a net addition to the lake's nutrient pool. The most significant component of the nutrient balance was the ground bait use of anglers that was not fully compensated by the fish harvest. It was also found that ground baits vary significantly in their nutrient contents, and hence, different bait types contribute to nutrient load of the lake to a different degree. Sustainable nutrient balance of fisheries management could be achieved by limiting the anglers' bait use to 1.5 kg day<sup>-1</sup> and restricting baits to those which have relatively low P (<0.3%) and N (<1.5%) contents. In turn, the rate of nutrient loading may be doubled if the present trends continue, and anglers will use 20% more bait with even higher nutrient content and will also show higher propensity to release the fish after catching.

This study was supported by the Sustainable Development and Technologies National Program of the Hungarian Academy of Sciences under grant FFT NP2022-II-3/2022 and the Széchenyi Plan Plus Program under grant RRF-2.3.1-21-2022-00008 (National Laboratory for Water Science and Water Safety).

## TITLE

**THE MULTIVERSE OF LAKE LANDSCAPE. THE CASE STUDY OF BOLSENA LAKE**

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The contribution examines the effects of neglecting water resource management on landscape quality in the Basin of Lake Bolsena, drawing from the qualitative data collected through in-situ studies. With its largest volcanic lake in Europe, this basin is distinguished by its remarkable biodiversity encompassing 12 protected species and 4 protected habitats (Natura 2000 framework). Additionally, it boasts a rich historical center present in 6 of 8 lacustrine municipalities, along with archaeological sites, and social heritage which includes vigilant monitoring associations and innovative planning tools such as the Lake and River Contract, and the Inner Area strategy. However, the historical absence of regulatory measures has amplified the adverse impacts in relation to ecological environmental risks (De Leo e Altamore, 2022; 2023). The Lakescape has receded from collective view and has a delicate balance now under threat from increasing anthropic pressures (ISPRA, 2022; PG-ZPS, 2009). Its distinctive conformation, characterized by a slow water exchange, renders it susceptible to alterations induced by intensive agriculture, degradation of riparian vegetation, unregulated groundwater extraction from neighboring aquifers, and inadequate wastewater management (Report Biodistretto, 2021; Mosello & Bruni, 2018; Biasi, 2010). This framework highlights a gap in taking responsibility for integrated water resource management planning.

In general, lakes face a convergence of environmental challenges, socio-economic intricacies, low population density, designated special protection areas, flourishing biodiversity, and intensive agricultural practices (Brillo, 2023; Snell, 2013; Lowell, 2001). The theoretical framework of this contribution takes as reference the multifactorial and multiactoral approach where the integrated Lake Landscape Management necessitates an in-depth understanding of the intricate territorial dynamics, with a particular emphasis on water management strategies (Lin, 2013). This contribution sheds light on anthropogenic pressure within the basin, extending to the lake's shoreline and how development choices led to the separation of two viewpoints in the basin landscape. One perspective regards the lake as a biophysical entity subject to control, while the other toward the territory where the water element apparently no longer exists. In this contribution, we will focus on this second point, identifying the critical liminal zones between water and soil.

The findings of this study underscore the inadequacy of isolated, sporadic interventions. Instead, the basin requires an integrated planning approach where water, landscape, and stakeholders collaborate to devise innovative strategies and implement actions to mitigate the impacts of climate change. This paradigm shift brings forth new challenges for the basin and all its stakeholders, requiring enhanced data collection efforts and a deeper understanding of the territory for the development of landscape projects.

## TITLE

**HYDRO\_ECO\_TOURISM COMMUNITY AS A SUSTAINABLE DEVELOPMENT ALTERNATIVE TO PRESERVE THE LAKE MOA**

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Unfortunately, marginal lakes always receive marginal attention from the Bolivian central government. Due to the high risk of drying up Lake Moa, has received more attention from local people, local authorities, and other stakeholders. Despite the existence of many natural resources, rural communities and in particular Native Peoples still maintain an economy based on basic extractive activities and their subsistence levels are precarious. Biodiversity is the foundation of ecosystem services to which human well-being is intrinsically linked. Being that the biodiversity, where the research area is located, is one of the highest in Bolivia, due to its proximity to the Madidi National Park, considered one of the most biodiverse on the planet, the project aims to develop some strategies to preserve the Lake Moa basin and its shallow water body. One of them is a Community-based ecotourism proposal that is ecological and linked to water resources management, which is why it is called the Hydro-Eco-Tourism Community Project (identified as a priority by the Takana's people), allowing the conservation and protection of the natural and cultural heritage of the Takana People, and increases the cultural resilience in face of climate change. The development of the Hydro-Eco-Tourism Community project is innovative due to its integrating components of hydrology and hydraulics, biology, and tourism, which will allow proposing the conservation of natural resources and above all the cultural conservation of the Takana people, rationally exploiting the tourism potential based on the Integrated Lake Basin Management (ILBM) process of the Lake Moa watershed. Lake Moa basin's lush jungle is home to exceptional vegetation and fauna, despite its small basin size of close to 800 km<sup>2</sup> and the 16 km<sup>2</sup> of the lake area. Lake Moa is currently in conditions of ecological disaster including the surrounding meanders and all the wealth of flora, aquatic fauna, etc., co-existing in the area, fully related to the Millennium Development Goals (SDG) that prioritize rural areas, traditionally the most vulnerable and poorest, and promoting the active participation and involvement in decision-making of women to overcome gender stereotypes. The main problem facing Lake Moa is deforestation in the basin, which in recent years has increased rapidly, projecting towards the year 2050 in the most pessimistic scenario, up to 50% of its forest would be deforested. Under these conditions, the availability of water in the basin on which Lake Moa depends is seriously affected, leading to a water shortage, adding to this is the affectation of climate change that mainly affects the reduction of precipitation by up to -19% and the increase in temperature up to +2.4°C. It has been determined that the minimum ecological depth of Lake Moa is 0.90 m. guarantees the survival of more than 20 species living in the lake. The water balance of Lake Moa establishes that the existence of the lake depends intrinsically on inflows from intervened and under-pressure sub-basins and that, if economically productive alternatives are not implemented, soon we would have to regret the extinction of the lake due to the various anthropogenic activities.

## TITLE

**IMPACT OF HEAVY METAL CONTAMINATION ON SOIL AND CULTIVATED VEGETATION WITH MITIGATIVE MEASURES USING NANOTECHNOLOGY**

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Lakes are vital parts of fresh water ecosystems of any country. A fresh water lake when maintained free from pollution can offer many beneficial uses in an urban area. Urban lakes more commonly act as thermal cooling, reaction centers and distressing points in the highly-stressed urban life. Lakes provide life to various forms of aqua flora and fauna, livelihood for fishermen community, food for the local populace, pollution sink, and ground water recharge leading to rise in the water table and also as flood mitigators. The aim of this study is to assess the extent of heavy metal contamination in soil and vegetation due to irrigation with sewage-led lake water on agricultural land of Byramangala reservoir, its catchment and command areas located in semi urban area of Vrishabhavathi river. Samples of water, soil and crop plants have been analysed for heavy metals, viz. Fe, Mn, Cu, Zn, Cd and Pb using atomic absorption spectrophotometry. The study reveals that the irrigation with sewage-contaminated water containing variable amounts of heavy metals leads to increase in concentration of metals in the soil and vegetation. The traces of heavy metals such as lead, Iron, Copper, Lead, Cadmium and Zinc were found in surface water of the reservoir. Traces of Heavy metals were found beyond permissible limits in soil, and different parts of vegetation which were fed with reservoir water for irrigation. The heavy metal transfer factor from soil to vegetation for Iron, Zinc and Cadmium is more for Fodder and radish. The heavy metals in the soil can be effectively immobilized by utilization of microbes for intra cellular and extracellular synthesis of nanoparticles with different chemical composition, size/shape and controlled monodispersity can be economically viable and ecofriendly strategy and also by application of nano-hydroxy hepatite (nha) chemical as one of the nano fertilizers of size < 20nm to immobilize the concentration of Pb and Cd contaminants. Also Nano-scale zero valent iron, bentonite-Nzvi, nanoalinite, nanocarbon dendrimers can be used as immobilizing agents. It has been previously shown that all nano-immobilizing agents proved high efficiency to reduce the level of DTPA extractable-Cd and Pb.

## TITLE

## REMOTE SENSING AND GIS BASED COMPARITIVE MORPHOMETRIC ANALYSIS OF KANVA RESERVOIR CATCHMENT AND MANCHANABELE RESERVOIR CATCHMENT OF SIMSHA RIVER AND ARKAVATHI RIVER BASIN

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In countries like India, where the population pressure is continuously increasing, land and water resources are limited and their wide utilization is imperative. Drainage basins, catchments and sub catchments are the fundamental units for administrative purposes to conserve natural resources. The catchment management concept recognizes the interrelationships among the linkages between uplands, low lands, land use, geomorphology, slope and soil. Soil and water conservation are the key issues in reservoir catchment management while demarcating catchments. Detailed morphometric analysis of a basin is of great help in understanding the influence of drainage morphometry on landforms and their characteristics. One of the advantages of quantitative analysis is that many of the basin parameters derived are in the form of ratios (dimensionless), thus providing an effective comparison irrespective of the scale.

Morphometric analysis of the reservoir basins is considered to be the most satisfactory method because it enables in understanding of the relationship of various aspects within a drainage basin, a comparative evaluation to be made of different drainage basins developed in different geomorphological and topographical conditions or situations. Detailed morphometric analysis was carried out using ARC- GIS for Manchanabele reservoir catchment of Arkavathi river system and Kanva reservoir catchment of Shimsha river system. Arkavathi River is the tributary of river Cauvery which covers a catchment area of 4038 sq km. Shimsha river is also a tributary of river Cauvery which covers a catchment area of 8469 sq km. Manchanabele Reservoir is constructed across river Arkavathi. Manchanabele Reservoir has an independent catchment of 152.99sq km. Kanva reservoir is constructed across river Shimsha. Kanva reservoir has an independent catchment of 356.14 sq km. The results of the morphometric analysis reveal that Manchanabele catchment is less elongated with high erosion and peak flow. It has a strong relief and steep ground slope. Kanva reservoir catchment is wider, has longer flow paths with more infiltration and reduced runoff. It has an average steep slope with medium relief. This study in conjunction with high resolution satellite data coupled with a geographic information system (GIS) will help to better understand the status of land forms and their process, soil erosion, drainage management and ground potential conditions for efficient reservoir catchment planning and management.

## TITLE

## FUNCTIONAL FOODS AND THEIR PRODUCTION POSSIBILITIES IN THE BALATON REGION

## AUTHOR(S)

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Functional foods contain components in adequate quantities that have a positive effect on vital functions, contribute to the prevention of diseases, have a health-protective effect, and overall have a positive effect on the human body. In functional foods, there may be more or less of a component, if the less is useful for the body in some way. In relation to functional foods, it is necessary to examine what component to add to the food, what effect can be expected from such food, what is the component from which the effect is expected, and what will be the product that the consumer buys. It is absolutely necessary to clarify the physiological effect of functional foods, consumer expectations regarding functional foods, the processes during which functional foods are prepared, food safety related to functional foods, and legal regulations. Food production is a new field whose technology is being developed, influenced, and accepted by customers today, so producers and consumers jointly control the processes that may be integrated into the traditional food production process in a few decades.

What physiological effect can we expect, and what diseases are functional foods recommended for prevention? The effects can be inhibition of oxidative damage, antimutagenic effect, inhibition of microbial infection, dietary fiber effect, immunomodulatory effect, neuroregulatory (nervous system stimulating) effect, estrogenic effect, anti-hypertensive (blood pressure lowering) effect, cholesterol-lowering effect and allergen-relieving effect. For the prevention of heart and circulatory diseases, heart-friendly foods have been developed, which e.g. have a cholesterol-lowering effect. Functional foods have also been developed to prevent obesity, and low-salt foods have also been marketed.

What functional foods are produced in the Balaton Region, and which of them have the least impact on the environment. Among the many functional foods, the production of grapes stands out, including the production of grape varieties from which excellent functional foods and red wine can be produced.

In low doses, red wine (and alcohol in it) can prevent thrombosis because it reduces fibrinogen and increases plasminogen concentration. It suppresses the coagulation of blood platelets, thereby preventing the development of atherosclerosis. It increases the concentration of protective (good) HDL-cholesterol and slightly reduces (bad) LDL, alcohol induces the production of one of the protein components of HDL-cholesterol. Those who consume one and a half to three deciliters of red wine have a 50% lower chance of developing cardiovascular disease, and their life expectancy is 10-12 years longer. Phenolic compounds, which occur in monomer, oligomer and polymer form, are responsible for the cardioprotective effect. During alcoholic fermentation, proanthocyanidins and anthocyanins are dissolved from the skin into the red wine, and the typical tannic aroma of red wines is also produced by phenolic compounds. The total phenol content of white wine is 170-300 mg/l, that of red wine is 1800-4000 mg/l.

In summary, among the components of red wine, the alcohol itself and the phenolic molecules from grapes, berries, seeds and skins have a beneficial effect. Due to their diverse chemical structure, phenolic compounds have different redox potentials, and thus can exert a synergistic effect with each other or with other natural antioxidants. Red wine-derived polyphenolic compounds have a positive effect on antioxidant, antithrombotic and vasorelaxing processes. The absorption of polyphenolic compounds from an alcoholic medium (wine) is easier than from an aqueous system (grape juice). Moderate consumption of red wine, 100-300 ml per day for men and 100-200 ml for women, with meals can theoretically reduce the rate of cardiovascular diseases.

## TITLE

**SEASONAL CHANGES IN CELL SIZE OF THE DOMINANT DIATOM SPECIES IN THE WATERS OF LAKE BIWA, JAPAN**

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We examined the seasonal changes in cell size and abundance of the dominant diatoms, *Aulacoseira granulata*, *Aulacoseira ambigua* f. *japonica*, *Fragilaria crotonensis*, and *Praestephanos suzukii*, together with environmental variables, in the northern basin of Lake Biwa. The cell size of the diatoms decreased gradually with the increase in cell abundance, indicating that the population underwent vegetative reproduction followed by sexual reproduction. The observation revealed two diatom blooms in a year. The autumn bloom from early October to late November was primarily dominated by *A. granulata*, *A. ambigua* f. *japonica*, and *F. crotonensis*. The minimum cell size of the diatoms recorded was 30, 20, and 75 µm, respectively. After that, *P. suzukii* dominated the mixing period, and the minimum cell size recorded was 18 µm. *F. crotonensis* caused a bloom from late March to early May; the minimum cell size recorded was 68 µm. These results suggested that *F. crotonensis* undergoes sexual reproduction twice a year, while the other three diatom species undergo sexual reproduction once a year.

Correlation matrices and redundancy analysis were performed to explore the relationship of various environmental factors to cell size reduction and restoration of the seasonally dominant diatoms, and it is suggested that water temperature and/or concentration of dissolved inorganic nitrogen are critical environmental variables for seasonal changes in cell abundance and/or size of the dominant diatom species. Our results demonstrated that each diatom species had distinct favorable ecological conditions for staging its life cycle.

## TITLE

**COMPLEX SYSTEM OF CONDITIONS FOR SUCCESSFUL SUSTAINABILITY PROJECTS**

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Based on our domestic and international experience gained in connection with our sustainability projects at various (community, organizational, local, regional and macro) levels, we are convinced that the issue of autonomy is closely connected with the implementation of sustainable (smart) development, which has now become a priority. Smart development means responses to the complex challenges of economic-social-technical development and in accordance with local conditions. In doing so, far beyond economic capital, the role of social capital, human capital, natural capital, and the level of governance must also be taken into account. And the complex system of different forms and levels of autonomies, overlapping, building on each other, plays an increasingly important role in their development. The simultaneous strengthening (development, coordination) of individual and collective autonomies is essential, and this requires appropriate, intensive and complex social marketing. For this, the correct diagnosis of the situation of the existing decision and action autonomies at a given place and time serves as a starting point. Our objective is to reveal the significant relationship between the elements of individual and collective autonomy and the sustainable development using multivariate statistical analysis based on local databases. We have shown that the higher the level of local autonomy, the more competitive a region is. This is closely related to the quality of human and social capital, government performance, and local innovation potential. In the case of development projects aimed at sustainability, the available economic and natural capital can only serve as a starting point. But local human, social and innovation capital is indispensable for the implementation of the project. It is not possible to import it. All of this applies even more when the external and internal challenges and changes accelerate exponentially and take effect in a complex relationship with each other. Because of this, the implementation of the planning of sustainability projects is a much more complicated task than before, and requires the arsenal of social marketing in addition to professional and financial knowledge.



## TITLE

**IMPACT OF STORMWATER POLLUTION ON OUR SURFACE AND GROUNDWATER RESOURCES**

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Pollution from the road network is complex. It consists of waste generated by traffic on the one hand, and waste resulting from traffic safety on the other. The main pollutants generated by traffic are crumbling of tyres, dripping of fluids used in vehicles, products of fuel combustion, crumbling of brake linings and metal parts, and other waste that ends up on the roads, mainly due to the misbehaviour of people on the roads. Metals from brake pad wear are typically: Cu, Sb, Pb. The metals from rolling wear of tyre linings are Zn, Cd. Depending on the volume and composition of traffic, stormwater runoff from the pavement of motorways can be significantly contaminated. Typical contaminants are TPHs and PAHs, as well as a group of heavy metals bound to fine solid particles of quasi-colloidal size.

The pollution of stormwater runoff from built-up areas (residential areas, industrial zones) and from roads in built-up areas has long been known. The quality of stormwater runoff in built-up areas is influenced by several factors, some of which have already been discussed in relation to transport areas and roof surfaces. Factors such as air pollution, emissions from motor vehicles, plant pollutants, animal faeces, solid waste, various types of discarded waste, anti-slip materials for the de-slippage of traffic areas, etc. are all factors.

These can be carried by rainfall on roads into surface or groundwater, damaging agriculture and crops along motorways and trunk roads, and indirectly our health.

What is the quick and easy way to ensure that rainwater falling on roads is properly treated in compliance with standards and limits? The equipment is a sludge and oil separation technology that can be installed in open surface watercourses and drainage ditches. Innovative and cost-effective systems can be built that can be operated efficiently over the long term.

Installed in trenches along linear installations (motorways, airports, railway tracks), even within municipalities, the equipment protects receiving watercourses, groundwater and the geological medium from pollution washed off by stormwater run-off from the surface. Innovative, cost-effective, and long-lasting, it is quick and easy to install, and can be efficiently operated, maintained, and cleaned afterwards.

It is much cheaper to install than conventional systems. It requires a third of the excavation work of conventional tank oil separation systems and can be installed above the water table in groundwater wetlands, saving the cost of groundwater injection. These two main cost drivers and other benefits make the investment and installation cost 30-50% lower, the maintenance requirements are transparent and can be visually inspected at any time.

## TITLE

**VIA KALEVALA - VIA ROMANA. ANCIENT ROUTES, CONTEMPORARY EXPERIENCE**

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In recent years a lot is being spoken about biodiversity and cultural diversity, the preservation of which is a pre-condition of a sustainable environment. Everyone knows that Finland is a land of lakes. Finns have had a responsible attitude to nature, based on a close-to-nature and dependant-on-nature mentality throughout the centuries. The country abounds in precious freshwater. This water resource is immense but vulnerable, with extensive lake surfaces connected under the rock beds in the depth.

The project described here can be considered the innovation of a regional cultural and travel agency based in Lahti. It was launched in 2016 when a handful of devoted volunteers re-visited both natural and cultural sites on a long march of nearly 1000 kms from the south-west across the Finnish-Russian border up to Northern Karelia. Hence the name Via Kalevala, as the area is the source region of ancient 'runo' songs. Participants were invited to follow in the footsteps of Elias Lönnrot, collector of folklore and the compiler of the Finnish national epos, Kalevala. The first tour was dedicated to him. Having repeated exactly the same trip as Lönnrot covered back in 1828, the project was extended to other territories of cultural, eco-cultural interest under the title "Via Kalevala 2016-2035". Taking into account the time span of the pilgrimage (as it is often referred to), the target group was active pensioners. Due to the war in the Ukraine and all its negative consequences, the project has been halted as across the border trips had to be suspended for the time being.

At first sight there are no equivalents to such a venture here on the shores of our primary destination, Lake Balaton. If you take a closer look however, you can easily discover venues, absolutely suitable for similar activities. Talking about routes, the ancient Via Romana (Római út) presents itself, connecting several settlements on the northern shores and slopes of the lake district. In the past few years, cyclists have discovered it, as the new bicycle path and Via Romana often overlap.

This paper focuses on the section of Via Romana which surrounds the mount of Badacsony. Badacsony, an extinct volcano, has a specific shape you can only perceive from the air. It is round(ish) with a wide shroud like a skirt on either side with the Roman road as its belt. Once the Romans, in our times certain winemakers invigorate ancient vines such as 'Bakator' or the endemic 'Kéknyelű' wine, and visitors are welcomed in family vineries and wine cellars. While in Badacsony (and the adjacent villages belonging to it), you can enjoy scenic views, the atmosphere of ateliers, art museums, local architecture, be it small chapels or the great two-towered church of basalt, the villa of a 20th century writer, observation points, a lookout tower, as well as the Research Institute for viticulture and environmental-friendly wine making technologies. All this along Via Romana or within a stone's throw.

## TITLE

## ASSESSMENT OF THE RISKS OF FOOD POISONING LINKED TO THE CONSUMPTION OF FISHERY PRODUCTS FROM POLLUTED LAKE NOKOUÉ, BENIN, WEST AFRICA

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Lake Nokoué is the largest lake in Benin, it is home to more than four million populations spread across the largest cities in southern Benin. There are several fish species which constitute the favourite dishes of its local residents.

The richness of its biodiversity and the particularity of its ecosystem have made it a Ramsar site for more than a decade. This lake is nowadays faced with pollution which is increasing day by day. This situation is not without consequences on aquatic fauna and on the food chain.

To better understand the phenomenon, the present work focuses on the assessment of the risks of food poisoning linked to the consumption of fishery products from Lake Nokoué. The methods used are spectrophotometry and atomic absorption. The materials used are the samples consisting of tilapia fish *Sarotherodon melanother* and shrimp *Penaeus duorarum*. As for the organic materials, they were determined by gravimetry after calcination of the dry matter in the oven at 550 °C. In the search for lead, cadmium, mercury and copper, an assessment of the health risks linked to the consumption of these contaminated products was carried out using a simplified standard approach. The results obtained reveal values exceeding the tolerated threshold for lead and copper for fish and shrimp samples taken in certain markets (2.85 mg / kg). Mercury is relatively negligible. On the other hand, the cadmium contents in fish exceed the standards in 80% of the cases (0.1 to 0.3 mg / kg). The risk assessment linked to the consumption of these contaminated products shows that the Daily exposition Dose (DED) / Acceptable Daily Intake (ADI) ratio for lead, cadmium and copper has been exceeded. As the calculation of DED/ADI is based on the weight of the individual, this result shows that children are more exposed to the consumption of these contaminated fish products than adults. Due to this, one can conclude that the fishery products from Lake Nokoué present a high health risk for children who weigh approximately 15 Kg.

## TITLE

## INVESTIGATION OF GROUNDWATER DISCHARGE AND PROJECTION OF FUTURE LAKE LEVEL CHANGES OF LAKE VELENCE BY USING NUMERICAL SIMULATION

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Soda lakes are a type of saline waters that are extreme physical and chemical environments characterized by special biogeochemical cycling and unique species. These unique aquatic habitats are dominated by  $\text{Na}^+$  and  $\text{HCO}_3^- + \text{CO}_3^{2-}$  ions and characterized by a stable alkaline pH due to carbonate buffering. Although they are less widespread than other saline water bodies, they can be found on all continents but predominantly in arid and semi-arid environments. In Eurasia, the westernmost occurrence of these habitats is found in the Carpathian Basin, where approx. 80-100 soda lakes and pans have been described until recently, among others, Lake Velence.

The water budget of the lake is especially driven by precipitation and evaporation, though upwelling groundwater plays an important role in the origin of its unique water chemistry. Despite this, groundwater conditions in the vicinity of the lake have not been investigated until recently, and the role of groundwater was left out from the lake's water budget. Our hydrogeological study proved that the lake is the discharge area of local flow systems with shallow penetration depth and short residence time. Knowledge of the groundwater flow system that discharges into the lakes enables to identify how the lakes will be affected by climate change, thus, it is imperative to investigate the interaction between the lakes and the groundwater.

In order to qualitatively and quantitatively investigate the nature of this interaction, a 3D, non-permanent groundwater flow simulation was carried out in the surroundings of Lake Velence by Visual MODFLOW 2011 between 1990 and 2021. To calibrate the model, the groundwater level time series of 46 monitoring wells and the measured lake level time series were applied. To assess the effects of climate change on the lake's level changes, we forecasted the lake level changes between 2022 and 2050 by using climate models obtained from the EURO-CORDEX database.

Our results showed that the groundwater discharge results in an average of 50 lake mm lake-level rise. This adds up to an average of 5% of the water budget of the lake. The lake level forecast revealed the vulnerability of the lake to climate change hence, the precipitation-evapotranspiration balance will be more and more negative toward 2050. This will cause a decrease in the yearly average relative lake level from 138 cm to 101 cm. By sustainable managing groundwater resources, we can ensure the water supply to the lake from groundwater, which can improve the lake's water balance. In addition, knowledge on groundwater flow systems enables the efficient use of managed aquifer recharge (MAR), by which more efficient water replacement can be achieved compared to surface water feeding channels, which are sensitive to evaporation.

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## TITLE

**TROPHIC STATE INDICES FOR APPLICATION IN THE MANAGEMENT OF LAGUNA LAKE, PHILIPPINES**

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Eutrophication that impacts economic services and ecological conditions of lakes can be assessed using a trophic state index (TSI). The TSI models of Carlson (1977), Toledo et al. (1983), Salas and Martino (1991), Lamparelli (2004), and Cunha et al. (2013) were tested and compared in the TSI determination of Laguna Lake which is the third largest lake in Southeast Asia and the largest in the Philippines. The key parameters chlorophyll-a, nitrate-N, nitrite-N, ammonia-N, phosphate-P and Secchi depth were used. Of the five models, the Salas and Martino TSI uses phosphorus loading rate. Applying these models, Laguna Lake is generally classified as hypereutrophic. Carlson's TSI model is considered suitable in classifying the trophic state of Laguna Lake. For conservative purposes, the lowest values of water quality parameters based on TSI thresholds are suggested for use in updating the existing national water quality guidelines. Up-to-date information on water quality parameters such as transparency, chlorophyll-a, nitrate, ammonia and phosphate that are consistently monitored by the government authority can be used in TSI determination. While water quality monitoring for environmental compliance is necessary, establishing the trophic state of Laguna Lake is vital in communicating the lake's real time condition to the public and in the definitive management of its eutrophication and productivity. Most lakes in the Philippines are not yet classified in terms of trophic state. Hence, trophic state determination using TSI will provide an overall assessment needed to enhance policies aimed at attaining sustainable ecological health and benefits of the lakes in the country.

## TITLE

**SUSPENDED SEDIMENT RESPONSE TO NORDIC BIOECONOMY AND CLIMATE CHANGE SCENARIOS IN A FIRST-ORDER AGRICULTURAL CATCHMENT**

## AUTHOR(S)

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Soil loss by erosion threatens food security and reduces the environmental quality of water bodies. Prolonged and extreme rainfalls are recognized as main drivers of soil erosion, and climate change predictions for large parts of the world foresee such increases in precipitation. Erosion rates are additionally affected by land use, which may change as a result of the shift from a fossil fuel-based economy to an economy relying on using renewable biomass, a "Bioeconomy". In this study we aimed at investigating, through modelling, i) if future changes in land use, due to a bioeconomy, would increase the risk for soil loss and enhance suspended sediment yields in streams and ii) if these changes, when combined with climate change effects, would further aggravate suspended sediment conditions in a catchment. We used hydrological and bias adjusted climate models to compare the effect of seven land use pathways on discharge and sediment transport relative to a baseline scenario under present and future climate conditions. The study was carried out based on data from a small headwater stream, representative for cereal production areas of S-E Norway. By modelling our scenarios with the PERSiST and INCA-P models, we found that land use change had a greater influence on both future water discharge and sediment losses than a future climate. Changes from climate showed strongest differences on a seasonal basis. Out of the modelled land use pathways, a sustainable pathway manifested the least occurrence of extreme flood and sediment loss events under future climate; whereas a pathway geared towards self-sufficiency indicated the highest occurrence of such extreme events. Our findings show that careful attention must be placed on the land use and soil management in the region. To maintain freshwater quality, it will be increasingly important to implement environmental mitigation measures.

## TITLE

## MECHANISM OF LACUSTRINE FISH COMMUNITY ASSEMBLY UNDER MULTIPLE ENVIRONMENTAL PRESSURES IN THE MIDDLE REACHES OF THE YANGTZE RIVER

## AUTHOR(S)

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The middle reach of the Yangtze River is a typical floodplain ecosystem consisting of a main river and a high density of lakes (one of the highest in China). It harbors a rich and unique freshwater fish fauna. In the past few decades, the lakes in the middle reaches of the Yangtze River have been disturbed by multiple environmental anthropic pressures such as water pollution, land use change, habitat fragmentation, and overstocking, and the composition and structure of fish communities have undergone significant changes. In recent years, China has fully implemented the Yangtze River ecological environment protection and restoration strategy, and the lake recuperation system has been gradually improved. Since then, lakes in the middle reaches of the Yangtze River have entered a new historical period of ecological restoration and succession, which provides a valuable historical opportunity and an ideal ecosystem for studying the mechanism of fish community assembly in the process of ecological restoration and succession of lakes. Clarifying the fish community assembly mechanism has important significance for the maintenance and restoration of lake biodiversity in the Yangtze River Basin. In this study, 26 shallow lakes in the middle reaches of the Yangtze River were taken as the research object. This study starts from the multiple environmental pressures faced by lakes in the middle reaches of the Yangtze River, and identifies key environmental factors that have important impacts on fish communities. And reveal the impact of its mediated environmental filtering and interspecific interactions on the species composition, functional structure and diversity of fish communities. A quantitative analysis of species co-occurrence patterns allowed a better assessment of the relative importance of environmental filtering, competition, and predator-prey interactions to community assembly. This study contributes to a better knowledge of fish community assembly rules, and also provides a scientific basis for the management and scientific protection of lake fish communities in the Yangtze River Basin.

## TITLE

## JOINT PRESENTATION WITH THE SHIGA PREFECTURE GOVERNMENT - VALUING, PROTECTING, CONSERVING, AND RESTORING VITAL WATER RESOURCES FOR CURRENT AND FUTURE GENERATIONS IN MICHIGAN

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Water defines Michigan and Michiganders. Our culture, heritage, economy, natural environment, and daily lives are deeply rooted in it. Michigan's two peninsulas are bordered by four of the five Great Lakes – together, the largest surface freshwater system on Earth. In addition, Michigan has more than 11,000 inland lakes, 76,000 miles of rivers and streams, 6.5 million acres of wetlands, and abundant groundwater resources. For generations, indigenous Indian Tribes have resided in the Great Lakes region and depended on the Great Lakes and Michigan's inland lakes, rivers, streams and groundwater for their way of life. Today, nearly 10 million Michiganders are among the more than 30 million people who rely on the Great Lakes for drinking water, sustenance, quality of life, cultural purposes, recreation, tourism, shipping, and industry.

Exploitation of native flora and fauna in and around Michigan's waterways and the state's emergence as a manufacturing center created great wealth and a high standard of living for many but also devastated native fish and wildlife populations and water quality and left a complex and costly legacy of contamination.

In 1972, facing public demands for environmental reforms, the United States and Canada signed the first Great Lakes Water Quality Agreement, to address a single issue: excessive algae in Lake Erie. Since that time, federal, state, tribal, and local regulation and restoration programs have driven progress toward ensuring drinkable, swimmable, fishable waters. In addition, recent investments by the federal government through the Great Lakes Restoration Initiative have accelerated restoration of water resources, fish and wildlife populations, and improved quality of life in many communities. But more work is needed.

For more than 20 years, Michigan has celebrated Great Lakes and Fresh Water Week in June to raise awareness of the immeasurable value of waterways to Michiganders' lives and livelihoods. The week encourages Michiganders to experience, enjoy, learn about, and share their love for rivers, lakes, and streams through recreation, cleanups, and actions to conserve and protect waters resources for current and future generations in the face of climate change and other challenges. In many ways, it is comparable to Lake Biwa Day in Michigan's sister state of Shiga Prefecture in Japan.

One example of the State of Michigan's efforts to promote water conservation and develop future stewards, leaders, and decision makers, is the From Students to Stewards Initiative launched in 2020. This ongoing initiative teaches students about the Great Lakes, Michigan watersheds, and the human impact on water resources and aims to inspire lifelong connections with freshwater lakes through student-led, hands-on experiences addressing real-world problems. This program also prepares students for careers in a variety of science, technology, engineering, and math (STEM) fields. Planting the seeds of stewardship with young people today positions Michigan for a future with generations of people who will care for and ensure the sustainability of the world's largest available freshwater ecosystem, the Great Lakes.

## TITLE

**BEYOND WATER - LAKE BASINS AS WINE AND FOOD TERROIRS**

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Lakes have a moderating effect on local weather and climate through mesoscale circulations of their surrounding region by reducing the maximum and increasing the minimum temperatures due to their large heat capacity and considerable albedo, they effect the formation of storms and lake breezes and the fluxes of heat and moisture. Thus, lakes influence the local water and energy cycles. Therefore, lakes tend to be in the centre of regions with typical products tightly connected to their origin which is particularly pronounced in case of wines such as the Three Lakes region in Switzerland, the Finger Lakes in the US, or the Okanagan Valley in Canada.

This study presents the geographical indications (PDOs and PGIs) that bear the name of a lake or whose production area is situated in a lake basin within or bordering Hungary, including three major lakes: Lake Balaton, Lake Fertő (Neusiedlersee) and Lake Velence.

The concept of the geographical indications (specified by EU regulations No 1152/2012 and 1308/2013) is based on the link between the quality and origin of products. By theory, this link is loose in the case of protected geographical indications (PGIs) and tight in the case of protected designations of origin. Our hypothesis is that lakes have a major influence on products using a PDO or a PGI as, by definition, these products are linked to their place of origin. We take 28 PDOs and PGIs from Austria and Hungary (wines, food and beverages and spirit drinks) into account and provide their brief presentation in the first step of the study.

In the second step, we analyse their product specifications using content analysis to detect the effect of the lakes on the products' quality. The results are mixed as in the case of spirit drinks and some larger wine PGIs, where the effect of the lakes seems to be negligible or not even mentioned in the product specifications. However, in some cases, the presence of a lake within or nearby the production area is deemed to have a substantial effect on product quality. Within our further research we are aiming to widen the scope for more regions to acquire a sufficiently robust database for the connection between the physical geography of wine regions and the character and quality of wines.

## TITLE

**INTRODUCTION AND PRESENTATION OF THE IKI LIVING LAKES BIODIVERSITY AND CLIMATE PROJECT**

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In the framework of the International Climate Initiative (IKI), the Living Lakes Biodiversity and Climate Project (LLBCP) contributes to the conservation and restoration of lakes and wetlands and the protection of related biodiversity. For 5 years, 14 Organizations from 13 countries worldwide (Cambodia, Colombia, India, Malawi, Mexico, Peru, Philippines, Rwanda, South Africa, and Sri Lanka, Germany and Spain) will work together in this project to archive its ambitious impact.

Wetlands are disappearing three times faster than forests. To foster the protection of wetlands and their biodiversity, the project will mainstream the conservation of lakes and wetlands into the political agendas at all levels and impulse innovative practical implementations: At the local level, the focus is on capacity development for actors involved in the use and management of lakes.

Addressing three main target groups (lake managers, farming and fishing communities, and political decision-makers), each member of the LLBCP is implementing actions in and around the lake or wetland in their country.

Through capacity development, training programmes, communication outreach and citizen science, the project will promote a more environmentally-friendly use of freshwater resources and the protection of climate and biodiversity. The focus for these activities will lie on women and youth, and the involvement of indigenous representatives will be key.

To stop further degradation of lake and wetland ecosystems, LLBCP is developing management plans and strategies to tackle climate change, water pollution, biodiversity loss and unsustainable agriculture and tourism. Local, regional and global strategic alliances are formed to improve the implementation of lake protection laws and management plans, strengthening of authorities, NGOs and their participation in stakeholder consultations. Technology and knowledge transfer exchange is facilitated through bringing together young lakes managers at global level. An expert pool, an exchange platform and international events are helping to form local, regional and global alliances and strengthen the Living Lakes Network.

## TITLE

**BLOOMING CYANOBACTERIA IN LAKE SEVAN, ARMENIA: DYNAMICS, DRIVERS AND GROWTH CHARACTERISTICS**

## AUTHOR(S)

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Lake Sevan (Armenia) is one of the large freshwater high-mountain lakes of Eurasia. Its water level fell dramatically in the past (by about 19 m) due to excessive use of water supplies for energetic and agricultural purposes which was paralleled with lake eutrophication. After undertaking restoration measures, the lake showed a tendency of ecological improvement. However, recently the lake has again shown signs of eutrophication which are clearly expressed by cyanobacteria-dominated phytoplankton in summer. The aim of the present study was to investigate the dynamics, drivers and growth characteristics of cyanobacteria proliferating in Lake Sevan.

The first step in our analysis was a literature review on historical occurrences of cyanobacteria in the lake. Water sampling for cyanobacteria, chlorophyll-a and nutrient analyses as well as water temperature measurements were done monthly at 0-0.5 m depths of 2-3 locations from April 2020 to March 2023. Lake surface sediment samples for cyanobacterial akinete quantification were collected in March 2021 and 2022 at 2 locations. A surface water sample for the lab observation of the growth characteristics of cyanobacteria blooming in the lake was taken in July 2022 at one location.

The observation of historical dynamics of cyanobacteria in Lake Sevan showed that the first harmful cyanobacterial development, expressed as a cyanobacterial bloom, was registered in 1964 and became a stable phenomenon until 1972. Cyanobacterial proliferations in the lake were again recorded in 1975, 2006, 2016 and 2018. These blooms were mainly caused by the rapid growth of *Anabaena* (now *Dolichospermum*) and rarely mediated by *Aphanizomenon*. The further observations in Lake Sevan showed a repetition of *Dolichospermum* bloom also in July 2020 and 2022 indicating about a new phase of eutrophication in Lake Sevan.

The investigation of temporal nutrient and temperature dynamics in the lake showed high mineral phosphorus concentration and temperature as drivers of cyanobacterial blooms in the lake, while low nitrogen content gave an advantage for the development of a nitrogen-fixing cyanobacterium. The study on cyanobacterial akinetes in the lake sediment concluded akinete germination as another factor favouring the cyanobacterial blooms.

Investigation of the growth characteristics of cyanobacteria blooming in Lake Sevan has shown that cyanobacterial bloom reaches its peak within 2-4 days depending on water temperature and starts to decline after 4 days. The overall bloom from start to end lasts 8-12 days, however, cyanobacterial blooms in Lake Sevan can last longer since the cyanobacteria in the lake proliferate heterogeneously, and the bloom events in different parts of the lake start and end in different periods of time. It has been shown that the higher water temperature causes intensification of bloom but reduction of bloom duration.

In such ecological conditions, the nutrient input reduction is the only tool to manage such unfavourable developments of cyanobacteria.

This work was supported by the Science Committee of MESCS RA in the frame of the research project no. 20TTCC-1F002 and by the German Federal Ministry of Education and Research in the frame of the research project SEVAMOD2 (funding ID 01DK20038).

## TITLE

**URBANISATION AND SOCIO-ECONOMIC DYNAMICS OF JAYAKWADI DAM AT PAITHAN, AURANGABAD, MAHARASHTRA, INDIA**

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Jayakwadi dam, located at Paithan taluka of Aurangabad district of Maharashtra is located at 19.4779° N, 75.3656° E. It is about 27 km wide and 55 km long, spanning over 350 km<sup>2</sup>. It is estimated that approximately 30% of the dam is filled with silt, reducing its life as well as storage capacity. Jayakwadi dam, a major project on the river Godavari was mainly planned for irrigation purpose. The performance of the irrigation system in correspondence to all indicators is low due to low irrigation efficiency, poor water control and management, deteriorated canal system, increase in area under perennial crops, high land holding, uncertainty in reservoir filling, etc. Irrigated agriculture requires high inputs as compared to rain fed agriculture. However, if water supply from irrigation system is variable, uncertain, and unreliable, farmers try to supplement the irrigation needs through use of ground water by exploiting it more and more when irrigation supply is unreliable. Reduced water flow to and from irrigation project has resulted into an increased rate of sedimentation of reservoir and has affected the regime of the river below dam. Quality of river water is not maintained due to stoppage of river flow. The middle and tail portion of canal system of Jayakwadi dam lacks from getting water for irrigation. This may be one of an important cause for low utilisation of potential of Jayakwadi dam. To resort to scientific mitigating and demand management measures to optimize the use of available water, it is necessary to operate the system in such a way to give benefit to large number of farmers. This can be achieved by supplying reduced quantity of water to individual crop and irrigating additional area with the water, thus saved. All the crops in the command area may not respond equally to water stress. Scientific approach will have to be followed to strike a balance between reduced water supply and maximizing the total production in the command as a whole.

Jayakwadi dam faces shortage of water particularly during low rain fall year mainly because of reduction in the yield due to increased upstream interception, diversion of available water for non-irrigation purposes such as domestic and industrial use, reduction of live storage by silt accumulation, revising guidelines for water planning in the basin, reducing evaporation from reservoir. Benefits other than agriculture like domestic water supply, industrial development, fish production, flood protection, tourism is substantial. Mitigation measures as suggested, if adopted, will overcome the problem of reduced water availability which is likely to cause to divert some water meant for irrigation to non-irrigation distribution purposes with increase in population for agricultural, domestic and industrial growth.

## TITLE

**THE ECOLOGICAL IMPACT OF SAILING INFRASTRUCTURE AND ELECTRIC WATERCRAFTS ON SHALLOW LAKES**

## AUTHOR(S)

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Although sailing boats and electrically powered vessels are regarded as environmentally friendly watercrafts, they in large numbers and their service infrastructure, such as ports and maintenance shipyards have an adverse impact on lake ecosystems, which is particularly pronounced in case of shallow lakes, such as Lake Balaton or Lake Velence. Every year, three major mass sporting events are held on Lake Balaton: the Blue-Ribbon International Sailing Race, the Révfülöp-Boglár crossing of Lake Balaton, and most recently the Fonyód-Badacsony-Fonyód route with any hand-powered craft, and the 8 km round trip between Zamárdi and Tihany. The vulnerability of Lake Balaton is further exacerbated by the accelerated fragmentation of coastal ecosystems due to grey infrastructural development of the coastal zone and the transformation of the riparian vegetation over the last decade. One of the main threats is the fragmentation of reedbeds, caused by illegal cutting, and creation of 10- to 200-metre-long entrances and built-in structures in the water. In the 80 kilometres of coastal reedbeds, there is an average of one of these arbitrary changes every 45 metres, which are damaging to nature, disturbing, and transforming the wildlife there and, in most cases, serving only a few people. These illegal actions and the vast environmental load on the coastal ecosystems must be eliminated. At the same time, experts accept the development of community waterways and other facilities in ecologically less sensitive areas under legal conditions taking into consideration the environmental carrying capacity of lake ecosystems. For all areas affected by any development, the protected areas must be presented and assessed, such as the natural sites, Natura 2000 sites, ecological network elements, the 2016-2017 classified reedbeds and other vegetation patches delimited in the reed classification, natural coastal areas, and protected species. The other important issue is the advantage of the electric propulsion systems. Electric boats are generally quieter, do not emit harmful gases and particles and are therefore more environmentally friendly than boats with explosive engines. This is particularly important in lakes where the impact on water quality and wildlife can be significant. Electric boats are generally less maintenance-intensive, lighter, and easier to manoeuvre than explosive boats. However, it must be kept in mind, that powerful electric watercrafts such as speedboats, jet skis and water scooters do seriously disturb shallow lake habitats and their use should be regulated accordingly. Furthermore, life cycle assessment should be carried out in terms of disposal and possible reuse of unwanted batteries...

## TITLE

**THE FERTŐ LAKE STRATEGY**

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In 2009, the Austrian-Hungarian Water Committee commissioned experts from both countries to prepare a development strategy for Lake Fertő. A catalogue of measures was completed in 2011, and the strategy document was approved in 2014. The study includes a comprehensive assessment of the status of water management, limnology, nature conservation and spatial development. The strategic documentation provides a good basis for the development of measures in various fields agreed between Austria and Hungary and for the elaboration of procedural methodological proposals for their implementation. The implementation of the measures is planned partly with national funds and partly with international joint projects, as cross-border cooperation is a must for the conservation of the lake.

The presentation will outline the hydrological and morphological characteristics of Lake Fertő and present the main elements of the strategy, its main conclusions and objectives. The poster illustrates the forward-looking joint work by organising the same information on a table.

## TITLE

**DECLARATION OF LAKE TITICACA 2022**

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In the framework of the International Climate Initiative (IKI), the Living Lakes Biodiversity and Climate Project (LLBCP) contributes to the conservation and restoration of lakes and wetlands and the protection of related biodiversity.

The 16th Living Lakes International Conference, organized in the framework of this project, was held in the city of Puno (Perú) from December 6th to December 8th 2022, hosted by the Binational Autonomous Authority of Lake Titicaca (Peru-Bolivia). In this occasion, the participants could engage in high level of discussion and reinforce the urgency of the actions needed to protect and restore wetlands and lakes worldwide.

The declaration of Lake Titicaca is the result of this exchange and the Living Lakes Network Members as well the conference participants have signed it. The Declaration of Lake Titicaca 2022, that can be downloaded here <https://www.globalnature.org/16th-living-lakes-conference>, calls on political decision-makers, the international community, civil society, academia and the private sector to take urgent action to protect and restore the world's lakes and wetlands.

Some of the most important themes addressed by the declaration are:

- There is an urgent need to strengthen existing legal frameworks to effectively restore and protect lakes and wetlands.
- Strong institutional and financial frameworks are urgently needed to promote wetland restoration.
- A World Water Fund is also needed to channel global resources to close the SDG gaps.
- Binding, science-based action plans are needed.
- There is an urgent need to financially support the implementation of methods and technologies to improve water quality.

## TITLE

**THE EXPERIMENTAL LAKES AREA: WHOLE ECOSYSTEM AQUATIC RESEARCH SINCE 1968**

## AUTHOR(S)

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The IISD Experimental Lakes Area (IISD-ELA) is an aquatic research facility that has operated since 1968 with the goal to understand the effects of human activities on freshwater and to find solutions to environmental problems caused by those activities. The IISD-ELA is a natural laboratory located in a sparsely populated region of Northwestern Ontario, Canada, that is comprised of 58 small lakes and their watersheds set aside for scientific research. By experimentally manipulating these lakes, scientists are able to examine how all aspects of the ecosystem, from the atmosphere to fish populations, respond to environmental disruptions. In addition to whole ecosystem experimentation, the IISD-ELA operates a Long-Term Ecological Research (LTER) program wherein meteorological, hydrological, water quality and fisheries data has been collected from several un-manipulated lakes and their watersheds since 1968. This data is one of the largest, most comprehensive data sets on freshwater in the world. Furthermore, these LTER lakes serve as "controls" for the whole ecosystem experiments to discern whether changes in the manipulated systems are a result of the manipulation or a product of natural variability. This unique research approach has influenced billion-dollar decisions of governments and industries and has generated cost-effective environmental policies, regulations and management, all to ensure the safety of our freshwater supplies. This talk will include some of the key historical experiments as well as the new large-scale projects currently being conducted by IISD-ELA staff and collaborators.



## TITLE

## EVALUATION OF CITIZENS' ACTIVITIES AND COLLABORATION FOR SUSTAINABLE SOCIETY IN LAKE BIWA BASIN - A CASE STUDY OF MOTHER LAKE GOALS (MLGS)

## AUTHOR(S)

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The "Act on the Conservation and Restoration of Lake Biwa" was enacted in 2015, and "Plan for Lake Biwa Conservation and Restoration Measures" was formulated by Shiga Prefecture. In order to implement this plan through the cooperation of various stakeholders and aim for a sustainable society in the Lake Biwa basin, 13 Mother Lake Goals (MLGs) have been set. In addition to the conservation of water quality, ecosystems, and forests, these goals include not only the conservation of the basin's natural environment but also the livelihoods of the people living in the basin, such as local disaster prevention, the utilization of local resources, and the inheritance of water culture. 13 expert evaluates each goal every year at the "Mother Lake Goals Academic Forum" to see how the natural environment and society have changed as a result of citizens' activities or collaboration aimed at these goals. This presentation will introduce the results of the evaluation of Goal 13, "Connect with each other to achieve the goals," which is related to civic activities and partnerships. This goal aims to create opportunities for people to connect, engage in dialogue, and share achievements.

To evaluate the outcomes of citizens' activities or collaboration, questionnaire surveys were conducted in March 2022 and March 2023. Comparing the results of these two surveys showed that for most GOALS, the percentage of people who were actively engaged in the past year increased slightly. The percentage of those who made new or ongoing efforts also increased slightly in most GOALS. In the March 2023 survey, a survey was conducted among general Shiga residents and organizations/individuals supporting the MLGs; the number of MLGs supporters increased slightly each month, reaching 1,460 at the end of June 2023. The results of the tabulation showed that a larger percentage of MLGs supporters were active in the past year than general Shiga Prefecture residents.

In the FY 2022, MLGs training seminars were held 53 times, and the number of participants significantly increased to approximately 3,000 people, compared to the previous year's approximately 800 attendees. The participants in these seminars included students, employees of private companies, members of citizen groups, and neighborhood associations. Most of these participants came from group or company that were different from those of the previous year. Such training seminars serve as the first step where participants can gain an understanding of MLGs' content and are expected to initiate activities in support of MLGs.

On the other hand, although the number of workshops held and the number of participants decreased, a variety of initiatives were still carried. For example, a wide variety of workshops were developed, including hands-on learning for forest utilization, learning about the local reed industry, development of MLGs exercises, removal activities for invasive aquatic plants, and the creation of artworks inspired by Lake Biwa. These workshops are diverse and open to anyone to propose. The organizers collaborated with MLGs facilitators to prepare these activities, and activities from various perspectives, expanded beyond traditional environmental conservation efforts.

## TITLE

## TOWARDS A SUSTAINABLE WATER LEVEL REGULATION IN LAKE BALATON

## AUTHOR(S)

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Lake Balaton – the largest lake in Central Europe by area – has extreme surface-to-volume (mean depth 3.5 m) and surface-to-catchment area (1:8) ratios in its size class all over Europe. Since the early 1900s, the lake has become the second most important touristic attraction in the country. Nowadays a significant economic sector depends on the ecosystem services of the lake and any news about the lake status draw broad domestic and even some international attention.

The shallowness and relatively small catchment of the lake imply high hydrological sensitivity to climate change, notably changes in precipitation and evaporation. Indeed, starting with the multi-year drought during 2000-2003, the repeated occurrence of years with net negative natural water balance became the new norm, while such years did not occur between 1921 and 2000. At the time of the record-low stage in 2003, the idea of an external water transfer was conceived as a measure that could stabilize the lake level during multi-year droughts. At that time, it was concluded that such droughts could be rarely returning phenomena and that the frequency of associated low water periods would not balance the associated risks of connecting catchments. By now, we know that negative years are quite frequent and may become dominant in the future.

Twenty four GCM-RCM chains from the RCP4.5 experiments of EURO-Cordex were used to predict natural water balance and possible water levels under different regulation strategies with a simple hydrological model until 2100. The results reinforce the climatic sensitivity of the lake. The further we progress in the future, regardless of the relative change in precipitation, more and more model chains indicate a declining water balance surplus, which manifest in multi-year excursions to very low water levels and up to decades without any drained water. These go well beyond the ranges accustomed by the society, which will soon re-heat the debate about water transfer. Recent observations suggest that future fluctuations and regulation of water level may profoundly influence the trophic status of this shallow lake, so level regulation needs to consider quality aspects besides quantity, too. We outline a regulation strategy preferred by the stakeholder community and determine the optimal capacity and operation frequency for a water transfer, which together can contribute to a sustainable utilization of the lake.

## TITLE

## INTEGRATED MODELLING OF IN-FIELD NATURAL/SMALL WATER RETENTION MEASURES USING THE MODEL SWAP IN A SMALL CATCHMENT

## AUTHOR(S)

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Assessing soil water availability for plants is crucial as it affects plant growth, crop production, and ecosystem functioning. Our goal was to investigate the changes in soil water balance elements if applying field-scale natural/small water retention measures (NSWRMs) under present and future climate conditions. Two study sites were investigated: a forest (2016-2021) and a vineyard (2020-2022). For continuous hydrological monitoring soil water and temperature sensors were placed 15 and 40 cm (and 70 cm for the forest) below the ground. We installed a meteorological station nearby in 2016, which collects data since. The study area is located in a small, agriculturally dominated catchment (21 km<sup>2</sup>) of the Csorsza stream feeding Lake Balaton in Hungary. The scenario analyses were performed using the SWAP model. The rswap R-package was used for manual calibration. Six different climate scenarios for three RCPs (RCP 2.6, RCP 4.5, and RCP 8.5) were developed for each of the study sites. The SWAP model was executed with the 18 future climate projections in combination with the three NSWRMs (afforestation, reduced tillage, and crops with higher drought tolerance). Three time periods (1991-2022 as reference, 2030-2060 as near future, and 2070-2099 as far future) were run. After the model scenario runs we analyzed the following water budget elements: water storage, transpiration, soil evaporation, and interception. Our preliminary results showed that without changing in the current soil management, most models estimate declining overall soil water storage (far future). Among the natural small water retention measures (NSWRMs), we found that the reduced tillage had the lowest amount of water stored, next to the drought-resistant plant, and the highest was observed for the baseline. We also found that the reduced tillage had the lowest amount of transpiration (approximately 222 mm per year), next to the baseline, and the highest was observed for the drought-resistant plant (255 mm per year). Based on the soil evaporation values we noted that the reduced tillage and the baseline managements had similar amount of evaporation, while the drought-resistant plant management had 3.2 % lower. Among the management methods, we observed that the reduced tillage and the baseline managements had similar amount of interception values, while the drought-resistant plant management had 3.5 % lower overall values. The water balance elements among NSWRMs were not significantly different; however, further fine tuning in the model input parameters are still ongoing. Overall, we found the SWAP is capable for estimating the effects of different NSWRMs at our research sites.

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## TITLE

## THE TRAGEDY OF THE COMMONS IN CASE OF LAKE ECOSYSTEMS

*SOCIAL AND ECONOMIC USAGES AND VALUING LAKE (ECOSYSTEM) SERVICES*

## AUTHOR(S)

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The Tragedy of the Commons is Hardin's concept, which illustrates that natural resources only serve, provide and add value to a community as long as its members fully comply with the rules that have been agreed upon, which is why this example is popular in environmental conservation. The accounting approach of quantified costs and benefits is increasingly becoming the holy cow of economics, despite the fact that it makes many simplistic assumptions, mostly ignoring the fact that ecosystem services are not inexhaustible, and is therefore inconsistent and seriously flawed. This is particularly pronounced in case of use and overuse of freshwater resources. There is also a misconception that local communities are clearly and alone responsible for the pollution of lakes and other surface waters and the degradation of wetlands. The examples of many Brazilian and Indian tribes living in harmony with nature prove the opposite, and there are countless cases where purely interest-driven public investments – such as dams, nuclear power plants, waterways, inadequate wastewater management, or intensive land cultivation – has led to major environmental disasters. The shallow lakes of Hungary and their hydrographic catchment areas can be regarded as continuously suffering aquatic ecosystems exposed to the adverse impacts of lake and riverbed regulation, grey infrastructure development on lake shores, pollution, excessive mass tourism, intensive agriculture and climate change. Eutrophication, i.e. the increase in the plant nutrient content of water and the resulting algal blooms, the presence of invasive species, water level fluctuations and habitat loss became an acute problem in the second half of the 20<sup>th</sup> century. A high level of awareness is needed among stakeholders responsible for or influencing lake management in the six lake-regions of the European Union. It is important that policy makers, NGOs and other organisations, companies and individuals involved in lake management will have a better understanding of how to protect and increase the resilience of lakes in the long term. Consequently, local control is essential, although it does not necessarily provide adequate environmental protection, it is necessary, since the integrity of the natural environment is inevitably compromised under excessively centralized and "remote" state control or the uncontrollable actions of politically and economically powerful private stakeholders. Thus, policy development, continuous environmental, social and economic monitoring and climate-adaptable development strategies are required for sustainability and resilience of lake ecosystems.

## TITLE

## TRANSFORMATION OF EX-MINING LAKES FOR MULTIFUNCTIONAL USE AND ECOSYSTEM SERVICES PROVIDED FOR THE STATE OF SELANGOR, MALAYSIA

## AUTHOR(S)

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## AFFILIATION(S)

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Bestari Jaya (formerly Batang Berjuntai) is a town and a mukim in Kuala Selangor District, Selangor, Malaysia. It is located 40 km NW from Kuala Lumpur. In the late 1960s, this area was one of the most productive tin mining areas in Malaysia. This activity changed the morphology of the land to a series of ex-mining lakes located along the upper stream of the Selangor River. Off River Storage (ORS) Bestari Jaya, Kg. Hang Tuah is man-made lake system consist of a series of 6 ex-mining ponds functioning as storage to divert some of the excess flow from the Selangor River during the monsoon season. This ORS system changes its functions as an alternative water resource during drought seasons. The water quality and quantity of the ORS system remains high due to water exchange. This lake system is one of the 20 ex-mining lakes gazetted as Alternative Water Resources under Section 48, Selangor Waters Management Authority (SWMA) Enactment 1999. Since 2014 and especially during the occurrence of the El Nino phenomenon, ORS Bestari Jaya played an important function to augment the Selangor River for water supply. Additionally, the lake is being used for water recreational activities and Canoe Sports Training Centre managed by Selangor Canoe Association. Furthermore, Selangor University, and the community of Kg. Bestari Jaya nearby which is known as Lake Neighbourhood (Jiran Tasik) collaborated to transform the ex-mining ponds into a spectacular place for community programs. Many NGOs such as Rotary Club, GEC, and Grassroot Moringa are also involved in the community efforts. Tree planting activities is one of the program. There were about 500 various type trees being planted in 2018 such as different species of forest trees, fruit trees, palm, and herbs, around the ORS of Bestari Jaya. In 2018, the World Water Day program for the State of Selangor was held at the ORS Bestari Jaya involving almost 1,000 participants. Now, the ponds have become one of the favourite spots by the visitors to enjoy the beautiful scenery and doing photo shoot activities in the weekend. ORS Bestari Jaya provided some facilities for the visitors. It has a cabin for Water and Environment Information Centre, an Open-air program venue, and others. There are special compounds in the area designated for camping and gathering activities. In order to increase the lake biodiversity, fish stocking program which involves local species such as lampam and puyu is also carried out. ORS Bestari Jaya has also won the Selangor Innovation Competition by the Selangor State Government for two consecutive years, 2017 and 2018. This proves that the multifunctional use of lake resources is the way forward in Integrated Lake Basin Management (ILBM).

## TITLE

## CHARACTERISTICS OF THE EUROPEAN LARGE LAKE REGIONS - LESSONS FROM AN ESPON STUDY

## AUTHOR(S)

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The presentation will present the environmental, social, economic and governance challenges and integrated regional development opportunities of the European large-lake regions, based on the results of the ESPON LAKES international research. In the first part of the presentation, I will highlight the basics of the ESPON LAKES project, then I will present the challenges of collecting, consolidating and analysing the data used, the methodological issues raised and the responses to them. The results of the analyses are then reviewed, with a focus on the environmental, social and economic characteristics of the three large lake regions studied: Lake Balaton, Lake Constance and Lake Vänern. This will be followed by a presentation of recommendations for the integrated development of the large lake regions, and finally I will conclude by summarising our results and presenting the lessons learned that are considered relevant for national spatial policy.

The statistical analysis of the regions of Lake Balaton, Lake Constance and Lake Vänern has shown that there are significant differences among the large-lake regions but that there are common points that link them. These include the significant ecological and cultural values of these regions, the networks of organisations and local actors, and that they are often located at administrative borders. For these reasons, it makes sense to develop the large-lake regions in an integrated way that takes into account the specific challenges of each region. Our results can also be used to inform Hungarian territorial policy, highlighting the role and development opportunities of regions facing specific challenges in the international arena.

## TITLE

## DOES THE GOVERNANCE FRAME VARY WITH ATTRIBUTES AND THE SIGNIFICANCE OF THE LAKE? A CASE STUDY FROM JAPAN

## AUTHOR(S)

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It is recognized that lakes and reservoirs are particularly difficult to restore once they experience degraded water quality due to long turnover time and other complex hydrological processes. Past studies on lake governance in Japan found that national legislation, the Law concerning Special Measures for the Preservation of Lake Water Quality (Lake Act) played a key role to strengthen local policies and actions by different stakeholders to establish necessary frameworks and management plans.

However, in this study, we have focused on non-designated lakes because these lakes have a different governance framework and policies from designated lakes under the Lake Act. We compared governance and policies between two categories of lakes. Lake Sagami is an artificial lake created in 1947 as a full-scale multipurpose dam with a size of 3.26 km<sup>2</sup>, being a source of 16% of the drinking water supply in Kanagawa Prefecture. Lake Sagami is a part of Sagami River, and upstream including the lake is managed by Kanagawa Prefecture. About 80% of the watershed is covered by forest in 2016, and the pollutant loads are mainly from non-point sources. Although the water quality meets the ambient water quality standard for COD category A, it fails to do so for the T-N and T-P. Since eutrophication affected the aquatic organisms and the process of water purification for drinking water, the Prefectural Government and the water users such as Yokohama City have taken various measures to improve the water quality of the lake since the early 1980s. Their actions include using equipment such as aeration machines and algae preventing fences and building plant purification facilities. They also manage domestic wastewater from nearby villages and ask citizens to maintain forests.

The governance of Lake Sagami is different from the one of lakes under the Lake Act, as limited stakeholders are currently involved. Rather than a multidisciplinary approach, actions to improve the water quality are mainly done by municipal drinking water suppliers (top-down approach), without a firm framework. In addition, the improvement also depends on infrastructure. Local ordinances to protect water resources have not been enacted, because the current management is sufficient to maintain the water quality. The location away from densely populated areas, the small size of the lake, and no conflict of interest among water users may favor maintaining the water quality; furthermore, taking prompt actions as early as the 1980s when cyanobacteria issues arose has prevented the water quality from worsening. While the study on designated lakes suggested that the strong leadership of policymakers, prefectural policies, robust coordination between vertical and horizontal government systems, and proactive stakeholder engagement (both citizens and industries) would lead the conservation, this case indicates the lake management can take a less stringent approach, as long as citizens and industry comply with other relevant policies such as ambient and effluent water quality standards, and water quality is regularly monitored.

## TITLE

## EMBEDDING LAKES INTO THE GLOBAL SUSTAINABILITY AGENDA

LAKES

## AUTHOR(S)

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The importance of lakes for society has been recognised for decades. Since 1986 ILEC has been promoting rational and sound management of world lakes. Yet, the current environmental status of lakes is one of large-scale degradation, threatening their societal and economic value, and the often unique biodiversity contained within and adjacent to these ecosystems. The international recognition of the need for global action on sustainable lake management is growing, most recently demonstrated by the UN Environment Assembly (UNEA) Resolution on 'Sustainable Lake Management' (UNEP/EA.5/Res.4) adopted at the resumed 5<sup>th</sup> session of the UNEA in February 2022. This follows a number of other adopted UN resolutions designed to reduce human pressures on lakes.

In recognition of these pressures, and the increasing global interest for ecosystem restoration, the UNEP convened World Water Quality Alliance (WWQA) Ecosystems Workstream launched a White Paper at the UN 2023 Water Conference entitled Embedding Lakes into the Global Sustainability Agenda.

The White Paper summarises the current state of the World's lakes and four Key Integrated Actions that are required to address the local to global management responses that remain fragmented, under-resourced and undervalued. This presentation will outline those actions of 1) Building Capacity in Monitoring and Assessment; 2) Embedding Sustainable Lake Management within National Policy; 3) Fostering Green Finance Partnerships; and 4) Raising Global Awareness of the Benefits of Change.

The results of a global survey of lake practitioners are included in the White Paper. This highlighted many of the challenges to sustainable lake management, that arise from multiple pressures and a lack of effective stakeholder engagement. Opinions on main pressures and options for successful management differed across regions and regional GDP. There are no simple solutions to improving the ecosystem health of lakes. It needs a multi-faceted and coordinated partnership approach across all concerned sectors and civil society. Bodies such as the ILEC and WWQA can play a pivotal role in this ambition. This will involve effective communication, often outside the "comfort zone" of the scientific community and the need for the development of communication strategies to build broader alliances that mobilise interdisciplinary cooperation and advocacy that, one step at a time, engages with and garners support of sectors that have been the drivers of negative change to pivot to positive change. The presentation will open up discussion for new ideas that can realise the ambitions of the White Paper.

## TITLE

**IMPACTS OF CLIMATE CHANGE ON ENDANGERED SPECIES IN LAKE BIWA: INSIGHTS FROM A DECADE OF ROV MONITORING**

## AUTHOR(S)

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<sup>1</sup> Lake Biwa Environmental Research Institute<sup>2</sup> Hokkaido University

Lake Biwa, the largest lake in Japan, has been significantly affected by climate change in recent years. Specifically, rising water temperatures and delayed or incomplete winter vertical mixing have resulted in severe oxygen depletion, posing critical challenges. In response, we conducted a ten-year ROV monitoring study to assess the status of endangered species in the lake.

Our findings revealed that in 2018 and 2019, Lake Biwa experienced consecutive years of incomplete vertical mixing, leading to the expansion of hypoxic water masses to depths of approximately 70 meters in the following year. This event caused substantial mortality among benthic organisms and a significant decline in population density of endemic species, such as *Jesogammarus annandalei* and *Bdellocephala annandalei*, distributed the deep area. Despite more than two years having passed, the recovery of these species has been slow and ongoing.

To further investigate the population dynamics, we employed a wide-range quantitative echo sounder for monitoring surveys. The results indicated a slight sign of recovery in the population of *J. annandalei*. However, the recovery process remains limited and incomplete. On the other hand, the ecological understanding of *B. annandalei* is still inadequate. Nonetheless, by developing a time-series predictive model, we determined that water temperature parameters are effective in predicting population density, enabling us to forecast recovery based on future water temperature scenarios.

These findings underscore the importance of continued monitoring and conservation efforts to address the impacts of climate change on endangered species in Lake Biwa. The slow recovery observed for *J. annandalei* and the limited knowledge of *B. annandalei* emphasize the need for further research on their ecological dynamics and the factors influencing their recovery. Mitigating the warming of large lakes is indeed a complex endeavor. Nonetheless, it is of utmost importance for government officials and stakeholders to acknowledge these signs and take proactive steps towards addressing climate change.

## TITLE

**CLASSICAL EUTROPHICATION - RECOVERY - INTERNAL EUTROPHICATION IN LAKE BALATON - IS IT THE TYPICAL FATE OF LAKES IN THE ANTHROPOCENE?**

## AUTHOR(S)

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Balaton is a large (surface area is 600 km<sup>2</sup>), shallow (mean depth is 3.7 m at 120 cm above datum level), elongated lake in Central-East Europe. The lake is situated asymmetrically in its catchment of 5400 km<sup>2</sup>. The largest inflow drains half of the catchment into the southwestern end of the lake, while the outflow is from the northeastern end. This gives rise to a strong SW-NE gradient with higher external loads and less favorable trophic conditions in the SW than in NE areas.

Rapid eutrophication dates back to the 1970s. In a decade, primary production doubled in the NE areas and increase eightfold in the SW ones. N<sub>2</sub>-fixing cyanobacteria, first of all the invasive *Raphidiopsis raciborskii* took over the dominance in the summer phytoplankton from dinoflagellates and diatoms in the latter areas. This was the era of classical eutrophication, when water quality deterioration was clearly coupled to excessive external nutrient loads (TP load was 3.4 and 7 mg m<sup>-2</sup> d<sup>-1</sup> in the NE and SW areas, respectively).

Eutrophication management started in the early 1980s. Major measures included the closure of 40 liquid manure producing animal farms along the main inflow, diversion of treated sewage from two thirds of the shoreline settlements, pre-reservoir (area is 70 km<sup>2</sup>) construction at the mouth section of the largest inflow, sewerage construction and sewage P precipitation at the regional treatment plants across the catchment, trapping the suspended solids load of small inflows. These measures decreased the external loads of both phosphorus and nitrogen by about 75% compared to the pre-management period. As a result, the trophic status of the whole lake was acceptable until the mid-2010s, even though cyanobacteria preserved their dominance in the SW areas.

In the last decade, a renewed eutrophication was observed in the lake despite the quasi constant external nutrient loads. This coincided with a climatic regime shift, a statistically significant shift from cyanobacteria to dinoflagellate dominance, and some new management measures. The lake entered the domain of internal eutrophication, where algal growth is fueled by an altered internal nutrient recycling. Similar phenomena are observed in many lakes across the Globe, presenting a new challenge for eutrophication management. There is no guarantee that the measures used to treat classical eutrophication are also suitable for treating internal eutrophication, leaving ample scope for the development of innovative lake-specific management plans

## TITLE

## ACTIVE LEARNING EVENT FOR CHILDREN TO GET NATURE EXPERIENCES AND RESEARCH ABOUT ENVIRONMENTAL ISSUES BY UNIVERSITY STUDENTS AROUND LAKE BIWA, JAPAN

## AUTHOR(S)

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International Volunteer University Student Association (IVUSA)

Lake Biwa, one of the largest lakes in Japan, is in Shiga Prefecture in northeastern Japan and is called the “mother lake” and has been loved by people for centuries. This lake is an important water resource that supports the lifeline of Shiga Prefecture and the neighboring Kansai area. However, Lake Biwa is also being affected by global warming, and its ecosystem is beginning to lose the balance. Therefore, Shiga Prefecture has created the MLGs (Mother Lake Goals) with the aim of achieving a symbiotic relationship between Lake Biwa and its people. MLGs are goals uniquely set for Lake Biwa to serve as a bridge between the SDGs and the local activities. In addition, our activity is also an action that contributes to the achievement of these goals.

The decline in opportunities for children to experience and connect with nature is a concerning issue that pays our attention in Shiga Prefecture. As the region experiences economic growth and development around Lake Biwa and its rivers, the natural spaces that once provided a playground for children to explore and learn about the environment are diminishing.

Therefore, we, the Lake Biwa team of the International Volunteer Student Association (IVUSA), organized the ‘Let’s Be a Researcher of Lake Biwa tour’. The purpose of the tour is to create a field where children, who will be responsible for the next generation, can learn and think about environmental issues in Lake Biwa together with university students. We hope to create an opportunity for children to deepen their understanding of Lake Biwa’s environmental issues and increase their interest in the lake through their own observations and experiments. Furthermore, we manage the event so that they can continue to enjoy exploring after the tour and acquire their own unique knowledge and skills that others do not have.

The ‘Let’s be a Researcher tour’ is an environmental learning event for elementary and junior high school children, in which children conduct fieldwork, experiments, and presentations on various issues and events around Lake Biwa. This presentation will introduce the ‘Let’s Make a Handmade Water Purification Plant tour’ held in March 2022, in which participants made a filtration system with a focus on the mechanism that makes water clean, and the ‘Yanamune River exploring the water and its creatures! Tour’ held in October 2022, which focused on the relationship between the ecosystem and the environment around the river. The contents of the event, the children’s findings, and their growth will be introduced.

## TITLE

## EFFECTS OF LEARNING EXCHANGE FOR CONSERVATION OF LAKES AND WETLANDS: LESSONS LEARNED FROM CEPA ACTIONS BY RAMSAR CENTER JAPAN

## AUTHOR(S)

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Lakes and wetlands are a part of rich and productive ecosystems providing a wide variety of goods and services. Looking back over history, however, the lack of understanding and recognition regarding the high economic value of lake and wetland ecosystems caused the rapid loss of biodiversity all over the world. There is increasing emphasis on the need for effective ways of valuing the ecosystems and gaining collaboration and cooperation of individuals and organizations to act on the drivers for its loss. In this regard, Communication, Capacity Building, Education, Participation and Awareness (CEPA) plays important roles on sharing knowledge and people’s engagement to promote wise use of natural resources in lake and wetland ecosystems.

Recognizing the above, Ramsar Center Japan (RCJ), which is a non- governmental organization, was organized in 1990 and since then has made efforts on promoting wise use of lakes and wetland ecosystems in the pursuit of fostering the mission of the Ramsar Convention in Asia. The paper addresses the significance of learning exchange through the NGO’s initiatives appropriate to participants involved. It introduces three practical initiatives (exposure visit, KODOMO (Children) Ramsar, and regional wetland networking) of the CEPA. First, knowledge translation for coastal lagoon management was effectively implemented by an exposure visit. RCJ attempted to connect a decision-maker working in Chilika Lagoon (India) to Lake Saroma (Japan) where similar interventions were made to re-connect the coastal lagoon to the sea, contributing to timely provision of decision-making for the ecological restoration in Chilika Lagoon. Second, RCJ focused on children (KODOMO in Japanese) who were involved in wetland education in Japan and other Asian countries. It is an exchange program that the children from different wetlands meet and explore learning the importance of wetlands through four activities (presentations, exposure visits, group discussion, and plenary discussion). The Kodomo Ramsar initiative has contributed to not only build the capacity of children but also mobilize adults to advocate for the development of wetland education for children such as establishment of eco-clubs that delivered engagement activities of the children on site. Third, an international wetland cooperation network across countries sharing the coast of the Bay of Bengal as a metaphor of a large lake was established and called as the Bay of Bengal Wetland Partnership (BoBWeT). The regional wetland networking has been effectively implemented by creating an environment for mutual sharing of benefits and raising voices in order to inform decision making process in the region such as advocating for the concept of crab banks. Irrespective of similar backgrounds behind lake and wetland ecosystems within the country and in Asia, there are few efforts to share lessons learned from lake and wetland ecosystems among the stakeholders. Based on the three initiatives, the paper provides implications for roles of NGOs serving as catalyst to bring the stakeholders together for wise use of lake and wetland ecosystems.

## TITLE

**“UNLOCKING POTENTIAL: LAKE BASINS AS CATALYSTS FOR SUSTAINABLE DEVELOPMENT IN ALBANIA”**

## AUTHOR(S)

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The idea of treating lake basins as functional development regions has gained importance in Albania to encourage sustainable economic growth while protecting the environmental integrity of these invaluable resources.

This paper examines goals and potential gains in Albania's lake basins to attain the intended results in lake basins, highlighting the importance of integrated planning, involvement of stakeholders, and a balanced approach through transboundary activities.

The Lake Shkodra basin is an exemplary case of practical development, successfully balancing environmental conservation with economic growth even in a transboundary setting. As the lake is situated on the borders of Albania and Montenegro, it requires joint management, preservation, and utilization, necessitating cooperation and coordination between the two nations. Both countries are obligated and motivated to maintain the ecological integrity of the lake, manage water resources, authorize activities, establish environmental objectives and standards for water quality, protect biodiversity, and address concerns such as pollution, fisheries, tourism, water usage, and cultural heritage preservation.

Decisions and actions taken in one country can impact the environment and water quality of a lake, which in turn can affect neighboring countries. To ensure the lake's resources are sustainably managed and protected, it's crucial that there are coordinated efforts and transboundary collaboration among all involved.

Efforts in transboundary cooperation and collaboration in the management of Lake Shkodra contribute to regional integration, foster peaceful relations between neighboring countries, and promote joint actions for environmental conservation and sustainable development. International agreements and mechanisms may be in place to facilitate cooperation and dialogue between Albania and Montenegro on issues related to the lake's transboundary context.

The WFD provides a framework for ensuring a coordinated and integrated approach to the management of transboundary lakes, promoting cooperation between countries that share such water bodies. This approach helps to address challenges related to water quality, ecological health, and sustainable use of water resources while fostering harmonious relations between neighboring countries.

This paper aims to analyze the application of ILBM principles and concepts in the implementation of WFD requirements and standards. This can be achieved through the joint synthesis of the concepts and objectives of ILBM and IWRM, to sustain a better management.

The Integrated Lake Basin Management (ILBM) methodology offers a comprehensive and holistic approach to water resource management, particularly in lake basins. It supports the European Union Water Framework Directive (WFD) implementation by promoting coordinated and collaborative approaches, fostering stakeholder engagement, data and information sharing, and a basin-wide approach. ILBM also emphasizes international cooperation for managing shared waters, facilitating joint efforts and transboundary agreements between countries sharing lake basins. This approach ensures sound scientific knowledge and monitoring data, promoting ownership and support for WFD implementation measures.

For the sustainable development and preservation of this priceless natural resource, collaborative management of environmental and cultural assets in Lake Shkodra requires cooperative efforts.

## TITLE

**MONITORING ILBM GOVERNANCE IN THE LAKE CHAPALA BASIN: 2010-2020.**

## AUTHOR(S)

Alejandro Juarez

## AFFILIATION(S)

Corazón de la Tierra Institute

The Lake Chapala basin (Mexico) has a high complexity due to its geomorphological and ecological features, diverse use of territory and complex social interactions linked to water uses (industrial production, cultivation, livestock, human consumption), generating conflicts and multidimensional impacts on local ecosystems. Recognizing the strengths and weaknesses of the governance system is necessary to guide efforts to improve the basin management. In this field, an evaluation of the governance based on six governance components (Information, Participation, Institutions, Policies, Technology, and Financing) as described in the Integrated Lake Basin Management structure (ILEC, 2005; RCSE and ILEC, 2014), was carried out in 2010 (Juarez, 2011) and 2020 (Tinoco, et al, 2021), using the Governance Diagnosis System (Juarez, 2013). This methodology identifies the perception of focal groups, including government institutions, research institutions, civil society organizations, productive sectors and others, interacting in discussion tables, analyzing available information and finally assigning values to a set of 60 indicators.

Comparative results 2010-2020 show interesting trends, particularly positive advances in the Participation component, due to an increase in the effectiveness of participation mechanisms, agreements and representativeness, although other key actors need to be recognized. The most reduced progress is observed in Financing: although international and private funds and specific budget items for basin management in the municipalities increased, federal and state budgets reduced dramatically.

Also there is a lack of transparency in the use of resources, decisions being made with scarce involvement of basin stakeholders. In the Technology component, there is a clear decline, although the use of hydraulic management alternatives and ecological health technologies and control of agricultural contaminants has increased, the level of coverage and efficiency in water treatment and the quality monitoring system is low.

It's important to mention that the workshops were accompanied with documentary research to back up the conclusions, being a strong correlation of available data with the obtained governance indicators.

Also, an online workshop with participation of almost 50 participants from 9 Latin American countries (Juarez et al, 2021) showed interesting coincidences with the aforementioned Lake Chapala patterns, indicating that similar cultural and political conditions could have a strong influence in the management of lakes in the Americas.

## TITLE

**CONSERVATION AND RESTORATION OF LAKES AND WETLANDS – A PERSPECTIVE FROM LATIN AMERICAN CASE**

## AUTHOR(S)

Alejandro Juarez

## AFFILIATION(S)

Corazón de la Tierra Institute

Mexico is one of the 13 countries working in the IKI Living Lakes Biodiversity & Climate Project (LLBCP). This presentation will analyze in detail the work and achievement of the Frontrunner Initiative implemented in Lake Chapala basin by the Corazon de la Tierra institute, the IKI partner in Mexico. Focus will be put on practical implementation related with strengthening of governance processes, through involvement of local farmer/rancher/fishermen communities, government institutions, research groups and civil society organizations, among others, with the common goal of reducing the impact of productive activities on the local ecosystems together with reducing emission of greenhouse gases.

**Background**

The project is being implemented in the Lake Chapala watershed, which is the largest natural lake in Mexico, classified as a Ramsar site. Ranching and farming cover around 50% of land in the direct lake basin, putting stress in forest areas through clearance practices, besides contributing with huge loads of nitrogen and phosphorus, which increase the eutrophication process. Besides, 46 toxic substances have been detected in the pesticides used broadly there, half of them extremely toxic for birds, fishes and phytoplankton. There is an increasing awareness about the links between the Lake and the environmental services it provides, with solid environmental networks being involved in the process. Nevertheless, there are still conflicting interests between different actors on the use of natural resources (water being the most important). Short-term policies and loose application of law amplify those challenges. Environmental policies have been advancing because of public pressure and international commitments.

However, productive activities (ranching and cultivation) still generate strong negative impacts on the local ecosystem, the services they provide and human health.

**Solution**

This project aims to reduce impacts on aquatic/forest ecosystems from productive activities (agriculture, livestock and forestry) in the Lake Chapala basin. This includes creation of two citizen councils to improve management of two Natural Protected Areas, new legal protection for 40.000 forest hectares and creation of two “Green rings of sustainable production”, with direct involvement of 8 communities, through training and implementing of agroecology and restorative livestock practices. With this a reduction of 800 tons of chemical fertilizers use is calculated, alongside with a 60% reduction in pesticides use. This project pays attention to foster gender equity, as previously done in other projects. Furthermore, extensive workshops and monitoring to improve the production activities are carried out with the local target groups in order to make possible the implementation of the aforementioned measures. Dissemination activities will also be key to ensure the involvement of key stakeholders.

## TITLE

**THE QUANTIFICATION AND MODELLING OF SEDIMENT PRODUCTION IN TIMAH TASOH LAKE BASIN, PERLIS, MALAYSIA**

## AUTHOR(S)

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Sedimentation is a frequent problem in the river basins, as it is in active areas with land use activities. Timah Tasoh Lake has suffered from deterioration of quality and shallowness of water due to sedimentation processes and the imbalanced development around the basin. These crises cause changes and problems in a lake, such as floods, lake erosion, sedimentation processes, and anthropogenic interference, which contribute to problems for humans and specifically river basin ecosystems. The main objective of this research was to assess and evaluate the point sources and non-point sources using hydrological and catchment models and identify environmental defense options for pollution, sedimentation, and erosion control in the lake basin. Spatial model of the sedimentation was applied using an interpolation tool known as Inverse Distance Weighing (IDW) in Geographic Information System (GIS). The integration of hydrology and GIS is quite a natural method for environmental research. The integration involves four major components, which are Event Mean Concentration (EMC) Values, Sediment Load Analysis (SL), Soil and Water Assessment Tool (SWAT) Analysis, and GIS Spatial Model Analysis. The proposed method integrates the losses due to overland flow, mass movements, and channel deepening and suggests an improvement to detect the places within the slopes with higher erosional activity in comparison to other methods to compute the sediment production induced by gully erosion processes. Based on the numerical result based on integration, which involves four major components, the sedimentation problems are more critical in the middle areas of the Timah Tasoh Lake Basin compared to the upstream and downstream areas. This sedimentation problem is due to unsustainable land use changes, cliff erosion problems, and active sand mining activities. This study suggests the sedimentation management methods including the application of existing integrated of river management methods based on Integrated River Basin Management (IRBM). The implementation of recommendations should be carried more specific for each sedimentation problems in Timah Tasoh Lake Basin to avoid and minimize various other problems that will occur from the proposed solution.



## TITLE

## APPROACH TO DERIVE TIMES SERIES CROP MAP AND MANAGEMENT DATA FOR ENVIRONMENTAL MODELLING IN A HUNGARIAN SMALL AGRICULTURAL CATCHMENT

## AUTHOR(S)

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Natural small water retention measures (NSWRMs) aim to protect water quality and quantity on agricultural catchment areas. Some of the NSWRMs are closely related to activities taking place on agricultural fields such as green cover, mulching, minimum tillage, no tillage, land use transition.

The influence of the different NSWRMs and other management characteristics – such as fertilization and soil management – can be analyzed with environmental modelling which requires field-level times series crop data further to the generally used DEM, land use, soil, hydrometeorological and water use/management input data.

In this study we present a method how time series crop data can be derived from open access data and how can we allocate possible management scenarios to the crop map. The field boundary-based hydrological response units (HRU) were the smallest objects differentiated in space for the prediction. We developed a random forest model by using the time series reflectance data of Sentinel-1A and -1B satellite radar images and Land Use / Cover Area frame statistical Survey (LUCAS) dataset to predict the crop types growing on each agricultural parcel. We applied the prediction method for the 2015-2021 Sentinel images on a Hungarian small agricultural catchment (Felső-Válicka). The accuracy of the derived maps was calculated on the cross-validated results of the crop classification and the proportion of each estimated crops was compared with the regional statistics and the data provided by a local agricultural company. Systematic errors in the estimation were identified and corrected (e.g., detecting winter barley as winter wheat) and the proportion of the predicted crops were modified based on the proportion of crops that is characteristic on the catchment. For the finalization of the time series crop maps possible crop combination conflicts were also considered.

Based on the time series dataset of the harvested crops it was possible to determine for each agricultural fields the land use related parameters, tillage and fertilizer application and other crop specific management operations that can affect water quality and quantity on the catchment. Detailed information about management practices was provided by local farmers. This data on the existing measures supports the more accurate potential allocation of further management scenarios to analyze their influence on water quantity and quality change in the agricultural catchment.

The presented research was supported by European Union's Horizon 2020 research and innovation program under grant agreement No. 862756, project OPTAIN and the framework of the Széchenyi Plan Plus program with the support of the RRF 2.3.1 21 2022 00008 project.

## TITLE

## STUDY ON PROPERTIES OF SEDIMENT SOIL IN BENTHIC REGION OF SALIM ALI LAKE

## AUTHOR(S)

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The historical planned town of medieval period: Aurangabad city (also known as city of gates) is situated in the state of Maharashtra, India. The monuments of ancient water supply system were found throughout the city which shows the enriched water distribution dynamics in that era. Priorly known as Khijjar Talao, this heritage was renamed as "Salim Ali Lake" when Dr. Salim Ali, a well renowned ornithologist of India visited on the site to protect this historical lake in 1985. A few ornate lotus flowers were bloomed in it in earlier period, which are found to be absent in present time. It is spread in the area of 32 acres having depth of approximately 10 meters. It comprises rich biodiversity, thereby providing enriched aquatic ecosystem to which different native and migratory birds select this lake as their habitat and breeding centres respectively. Around 140 migratory bird species visit this lake in every winter season. Salim Ali Lake is geographically situated on 19°53'N and 75°20'E. The present research work emphasised on the study of benthic zone in correspondence to the quality of lake water. The study had been conducted for one year, i.e., January 2022 to December 2022. Being at a position of low-lying plane, the phenomenon of siltation occurs in this man-made lake, thereafter making the benthic zone of crucial significance. Moreover, the existence and working of an STP set up by the Municipal Corporation of Aurangabad leads to the discharge of treated wastewater in the lake. Benthic zone owns its importance due to the primary production of nutrients through the congruence of lake water, sediment soil and pollutants too. The decomposition of organic waste further leads as a catalyst in the nutrient formation. Hence the benthic region of Salim Ali Lake is an essential factor of study leading to the plethora of the further research work in this domain. In the age of rapid and vast urbanisation, where water bodies and their aquatic ecosystems are hampered due to several reasons like unavailability of water, natural calamities, contamination in water bodies along with several anthropogenic factors of pollution, this cultural water heritage still serves as a gem to the smart city of Aurangabad.

## TITLE

## LAKE ENVIRONMENT AND DISASTER RISK PREPAREDNESS: ANALYZING THE FACTORS TO OVERBRIDGING THE GENERATION GAP IN A RURAL AREA

## AUTHOR(S)

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Ecosystem-based Disaster Risk Reduction (Eco-DRR) has been employed in flood risk management in Japan. It is expected that local citizens will participate in local environment conservation. In the time of many rural areas ageing, it is important to ensure the participation of citizens while raising their awareness of flood risks. This study focuses on rural areas where the population is ageing and aims to suggest the tasks to be addressed in the social implementation of Eco-DRR in the future by clarifying the differences in disaster risk preparedness and interest in the lake environment and conservation between the elderly and the next generation who will be responsible for the local community. This study conducted social surveys (questionnaires and interviews) targeting ordinary citizens in a small city in Shiga Prefecture, located in the basin of Lake Biwa. Using the multi-correspondence analysis method and qualitative analysis (mixed method), it analysed the relation between disaster preparedness and interest in the lake environment and conservation. The questionnaire results showed that the association between their preparedness for flood risks and local environment conservation is more robust in older people. The younger generation likes the local area, but they feel reluctant to participate in local activities and have less pride in being a member of the local community. While it clarified that preparedness for disaster risks and local environment conservation are overall lower in the younger generation, it was also found that their interest in the lake environment and natural resources located nearby can be a key to overcoming the generation gap in attitudes toward disaster preparedness in the rural area. The interviews and qualitative analysis elucidated that they have overcome their physical difficulties through their traditional bonds nurtured in communication in normal times in the past flood cases; hence, they have more trust in their ties with local people to get information and mutual help rather than the modern technologies such as SNSs that they neither are familiar with nor know how to use. This study suggests creating opportunities in workshop style in both real and virtual, using the lake environment as a critical factor. As disaster risk is one of the common issues for all generations, this study proposes a matrix-making workshop based on the findings aiming that different ages can exchange their ideas about their responses to disaster emergencies in the future social implementation of Eco-DRR.

## TITLE

## ROLE OF CLIMATE CHANGE IN RISING WATER LEVELS AND UTILITY OF INTEGRATED LAKE BASIN MANAGEMENT FOR RESILIENCE BUILDING IN KENYA

## AUTHOR(S)

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Since 2011, the Eastern Africa Rift Valley lakes in Kenya have registered significant increases in size. Increasing rainfall intensity recorded in the Kenya Highlands highly correlate with the rising levels of these lakes. The rising water levels has been a major cause of concern to the country's socio-economic development, and this has led to many uncertainties in the counties where these water bodies are located.

In 2020/2021, the Ministry of Environment and Forestry, constituted a multi-agency team to assess the status of the rising water level in the lakes and dams, determine the cause(s); assess the impacts and propose interventions required to mitigate the effects of the rising water levels.

The teams used two approaches to collect information on the causes and socioeconomic impacts of rising water levels, namely, satellite image processing and GIS overlay, and field scoping.

The results reveal a complex interplay of hydro-meteorological factors, land use change dynamics as well as the geology and morphological setting of the lakes which have relatively influenced the current phenomenon. The rising water levels are changing the composition of lake water thus affecting biodiversity. This is manifested in the reduced number of flamingos, which feed on algae whose growth has been affected by the change in alkalinity/salinity of the lake waters. Tourism in the areas has drastically reduced owing to the loss in aesthetic value of the lakes and affected incomes.

The long periods of the rising water levels in these lakes have generated a humanitarian crisis. Approximately 75,987 households have been displaced with a total population of 379,935 requiring humanitarian assistance.

The rising waters levels have destroyed social amenities like learning institutions, health facilities, markets, fish landing and processing facilities, hotels, resorts and lodges, electricity lines, water supply and sanitation units (boreholes, shallow wells, sanitation facilities) as well as road networks, forcing many to use boat transport to access services across the flooded areas.

To sustainably manage the lakes and their basins, the National Lake Basin Management Strategy has prescribed utilization of Integrated Lake Basin Management (ILBM) as a framework for the sustainable management and use of Lake Basin resources through informing policies, strategies, plans, projects and programmes, as well as to guide coordinated actions.

## TITLE

**APPLICATION AND RESULTS OF AN AUTOMATIC MODULAR WATER QUALITY MONITORING SYSTEM IN DIFFERENT CATCHMENT AREAS**

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According to the Water Framework Directive (WFD) 2000/60/EC our waters have to reach the water quality category of good quality. In order to elaborate on the required programs information is needed.

The aim of the research project is to present the role of the modular automatic Water Quality Monitoring System, to present experiences, challenges, and future plans, as well as to present the information potential inherent in the time series data collected in the database.

This research aims to contribute to the environmental protection and sustainability of the rivers and lakes.

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## TITLE

**IRRIGATION, CONSERVATION, RECREATION AND WHO COVERS THE COSTS?**

## AUTHOR(S)

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The relationship between standing waters/lakes/ox-bows and the surrounding catchments is determined by highly complex interactions. They provide a water base for water users in the region, have significant nature conservation potential as habitats and are of particular importance in meeting the recreational and tourism needs of the people living in their catchment areas. The Holt-Tisza in Martély is an ox-bow of outstanding natural value in south-eastern Hungary, in the left bank of the Tisza. Over the decades, a high level of recreational needs has been developed on its banks and a holiday resort of outstanding importance for the people living in the area has been built. The sustainable good water quality can be ensured by the operation of the irrigation system installed on the estuary, but the integration of the ox-bow into the irrigation system water flow generates significant water losses in the irrigation systems, which significantly increase the price of the water used. This paper will describe the different functions of the ox-bows and their beneficiaries. The role of the basin in the water flow of the region is analysed, with particular emphasis on its role in agricultural water supply. The analysis includes the costs associated with the different functions and their virtual and real bearers. The paper will analyse the past havana situations and conflicts related to the water space of the ox-bow. A proposal is made for measures to improve the current conditions and their cost bearers.

## TITLE

## THE OPERATION OF BALATON ONLINE MONITORING PLATFORMS

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The water quality changes of Lake Balaton have a significant impact on recreational water use. For more detailed monitoring of water quality changes, 3 online monitoring platforms were created within the framework of the LIFE Balaton Project (2003-2006). Based on the operational experience of these observation stations, 4 new, improved platforms were commissioned in 2022. The system provides water quality, meteorological, hydrographic data to scientists and the public, and part of the storm warning system.

The surface water blooms of Lake Balaton were first described at the end of the 1960s. From 1978 to 1994, yearly mass production of filamentous blue-green algae became typical. After 1995, the water quality improved significantly, but in the last few years, surface algal blooms reappeared, first near the coast, then also in open water. Algal biomass has also changed drastically in recent decades. The water of the western basins of the lake usually became hypertrophic at the end of summers between 1982 and 1994. The dominant algal species in these years was *Raphidiopsis raciborskii*. Between 1995 and 2018, blue-green algal blooms did not occur.

Changes in water quality can be evaluated much more effectively based on data measured with high frequency. This is especially true for surface water blooms, which can form and disappear very quickly, making more difficult to detect and record them with occasional sampling. It was an unfortunate coincidence that the old monitoring system stopped in 2018, just one year before in 2019 a record-setting mixed bloom of *Ceratium furcoides* and *Aphanizomenon flos-aquae* developed unexpectedly.

The new, improved monitoring platforms started operating in 2022 and provide continuous, reliable data series from all 4 basins of the lake. Unlike traditional sampling-based monitoring, detailed daily and seasonal changes can be registered and evaluated with high-frequency continuous data recording. In addition, events that otherwise would not have been detected can be recorded. The interpretation and documentation of the measurement results are also aided by online and archived images recorded by webcams. The data measured on the water surface help to prepare and calibrate trophic maps based on remote sensing.

Real-time data is also very useful for informing the public. In this case, incorrect data, such as measurement errors, must be removed before publication. Algorithms have been developed to filter out incorrect or uncertain values. Thus, the published data series are up-to-date, and at the same time, misunderstandings and false alarms based on incorrect data have become avoidable.

To analyze trends, the study employed pixel-based linear regression, Modified Mann-Kendall trend test, Innovative Trend Analysis (ITA), and Sen's slope estimator. Results showed a strong positive correlation ( $r=0.9$ ) between MODIS LSWT and in-situ water temperature, with reasonable errors (RMSE=1.6°C, MAE=1.48°C, MBE=-1.48°C, MAPE=6.25%), indicating the good agreement between the two data. Likewise, a strong positive correlation was observed between in-situ water turbidity and NDTI ( $r=0.92$ ) and between in-situ Chl-a and NDCI ( $r=0.84$ ), suggesting the applicability of these indices for estimating turbidity and Chl-a levels in Lake Tana. LSWT showed significant spatial and temporal variability across the lake. The southern, eastern, and southwestern parts experienced higher LSWTs, while the central and northern regions exhibited relatively lower LSWTs. Increasing trends of LSWT were observed in the northeastern, northwestern, and southwestern regions while decreasing trends were observed in the western, southern, and central parts of the lake. The LSWT trend decreased significantly in autumn, spring, and summer at cooling rates of 0.013°C yr<sup>-1</sup>, 0.012°C yr<sup>-1</sup>, and 0.016°C yr<sup>-1</sup> (2001-2022,  $P<0.05$ ), respectively.

However, the LSWT trend increased insignificantly in winter at a rate of 0.001°C yr<sup>-1</sup>. The spatial mean annual LSWT also decreased significantly at a cooling rate of 0.12°C yr<sup>-1</sup> (2001-2022,  $P<0.05$ ). Water quality parameters showed significant spatial and temporal variability over the lake, with higher turbidity and Chl-a concentrations in the eastern, northeastern, northwestern, and southwestern regions, and lower values in the central and western regions during all seasons. Turbidity levels ranged from 1.5 to 81 NTU, and chlorophyll-a values ranged from 10.5 to 349 µg/L in June 2023. NDTI exhibited a downward trend in all seasons (2016-2023), but the decrease rate was not significant during spring ( $P<0.05$ ). Likewise, the NDCI trend significantly decreased in spring and summer and insignificantly increased in autumn and winter. LSWT was positively correlated with NDTI and NDCI in all seasons with varying strengths. Furthermore, the study reported a positive correlation between LSWT and near-surface air temperature across all seasons, with the highest correlation in summer ( $r=0.68$ ) and the lowest in winter ( $r=0.25$ ). Overall, Lake Tana's water quality improved from 2016 to 2023, possibly due to the expansion of water hyacinths and Illinois pondweed along the shoreline. These findings will provide valuable information for water resource managers and relevant stakeholders to develop short and long-term management plans for preserving the lake environment.

## TITLE

## PROJECT-BASED UNIVERSITY EDUCATION'S GLOBAL OPPORTUNITIES IN SPECIFIC TOPICS OF NATURAL LAKE PROTECTION AND SUSTAINABLE WATER MANAGEMENT

## AUTHOR(S)

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The significance and transformations of higher education in the 21st century are examined, with attention to global trends and challenges. The combined insights from reports by OECD, UNESCO, and the World Bank underline the benefits of higher education not only for individuals and the economy but for society at large. These reports collectively highlight the critical role university networks play in understanding and addressing global issues, particularly the protection of lakes and sustainable development.

The application of project-based education across both university and local levels introduces a fresh dimension in higher education. Such an educational approach amplifies students' commitment and interest in research topics, while they acquire applicable knowledge and tackle real-world problems. Project-based learning emphasizes collaboration and a multidisciplinary approach, fostering a deeper understanding of specific subjects and the formulation of more effective solutions. This teaching methodology ensures that students gain not just theoretical knowledge but also practical skills, indispensable in the realm of "Natural Lake Protection and Sustainable Water Management."

The study also delves into how project-based education is the most efficient pathway for higher education to address specific topics. Such a pedagogical approach ensures that students interact directly with actual problems during their studies and acquire the necessary practical experience to handle future challenges.

In conclusion, the study underscores the need for scientific and practical professionals to seek close collaboration with universities. The foremost task of future higher education will be to prepare students for the changing world's challenges and the expectations of active global citizenship.

## TITLE

**DECLINING WATER QUALITY AND WATER HOLDING CAPACITY OF A TROPICAL LAKE**

## AUTHOR(S)

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Changing climate and increasing anthropogenic pressure lead to ecological degradation of the largest designated wetland, the Vembanad Lake in the southwest coastal state Kerala in India. The lake provides livelihood to millions and is rich in biodiversity. More than 60% of the inland fishers in Kerala depend on Vembanad for their livelihood while it is also a source of sustenance for hundreds of others engaged in allied activities. Environmental degradation makes the region inhospitable to living organisms and affects livelihood of the wetland dependent communities. Canals and rivers carry tremendous loads of sediments and pollutants into the lake. Failure in project implementation to multiply rice production in the Kuttanad region (declared as Globally Important Agricultural Heritage Systems by FAO for the below sea level farming system) within the lake area contributed much to the deterioration of water quality as the natural water purification system was badly affected. Encroachment and development projects reduced the lake area. Water-borne and vector-borne diseases affect more than half of the population every year. Cancer and kidney diseases are increasingly observed in regions surrounding the lake. Plastic pollution in the lake is much higher compared to other lakes. Fish diversity decreased from 150 species to 90 species in last 50 years. Climate change, hydrological regime change, pollution, invasive species and illegal fishing practices are responsible for this. Many species of fishes and birds disappeared. Changing climate adds to the anthropogenic pressure. Increasing seasonality and intensity of rainfall and floods leads to large-scale sedimentation in the lake. Encroachment and sedimentation has significantly reduced the area of lake. Abnormal floods in 2018 and 2019 resulted in large scale sedimentation and pollution input. The water retention capacity of the lake has got reduced by 85% in the past 120 years due to sedimentation due to climate change, climate massive encroachment and destruction of its ecosystem. Area of the lake was reduced from 365 Sq.Km to 206.30 Sq.Km. Changing rainfall pattern and reduction in summer rainfall invite salinity intrusion far inside. Changing climate and rising sea level are major threats to the lake. Lake degradation leads to several socio-economic issues such as increasing rural poverty, food and water crises, migration and conflicts over resources allocation. Sustainable management of the lake and strategies for adaptation and mitigation under a changing climate and rising sea level is of utmost importance. A master plan to address the challenge of climate change, pollution, flooding and sedimentation in the lake is to be developed. Measures for this often fail because of various socio-economic and political reasons. Present study is an assessment of the impact of climate change and anthropogenic pressure on the lake ecosystem. Possible changes in river input into the wetlands under an altered climate in near future have been estimated. Existing policies and strategies have been critically reviewed to suggest guidelines for an appropriate policy to face the future challenges.

## TITLE

**WHAT THE EU NATURE RESTORATION LAW MEANS TO THE LARGE LAKES IN HUNGARY**

## AUTHOR(S)

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Great Lakes and Wetland Association

The loss of lakes and wetlands in Europe is a significant environmental concern with wide-ranging impacts on ecosystems, biodiversity, water resources, and human well-being. Over the years, Europe has experienced the degradation and loss of many lakes and wetlands due to various factors, including urbanization, agriculture, drainage, pollution, and recently climate change. Between 75% (Netherlands) and 90% (e.g. Ireland) of wetlands in EU member states have been lost, and Hungary unfortunately faced with the 2nd largest loss of wetlands. Of the wetland area converted to other land uses between 1990 and 2000, 2 % were artificialized (e.g. urban areas), 7 % became agricultural, 12 % water bodies, and 79 % forest and semi-natural areas (EEA, 2009). While the EU Water Framework Directive resulted in positive changes after its introduction, the positive tendency stopped in the past years.

Wetlands are still exploited and converted in Hungary, so the EU Nature Restoration Law offers a great opportunity to turn the tendencies and – apart from protecting those freshwater ecosystems that remained including great lakes – restore large pieces of wetlands. Our great lakes are center pieces in conducting such a restoration effort.

The European Living Lakes Association (ELLA) thus calls for a strong Nature Restoration law that puts in place restoration measures that together shall cover all ecosystems in need of restoration by 2050. This file will be key to achieving healthy wetlands, which are crucial to delivering both European and International commitments in the European Green Deal, the EU biodiversity strategy for 2030, the Paris Agreement, and the Convention on Biological Diversity. All actors must significantly increase their efforts so that lakes, wetlands and other surface waters in moderate, poor or bad ecological status will be successfully restored. To plan and implement such actions, challenges such as eutrophication, acidification, pollution, water abstraction, and hydrological and morphological alterations must be addressed immediately and more efficiently.

This presentation will be part of the session organized by ELLA on 7 November between 16:00 and 17:30 and will focus on the civil society work conducted by the member of the Great Lakes and Wetlands Association.

## TITLE

**HOW DOES THE DOWNSLOPE WIND IMPACT THE WEATHER AT LAKE BALATON?**

## AUTHOR(S)

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The weather at Lake Balaton depends on many factors. While in most of the Transdanubian the weather is influenced only by large scale meteorological processes, the lake and near by the Bakony Mountains make up a system which can modify the large scale weather locally. Due to this local effect the wind speed can be larger by the value of 30-40 km/h, furthermore the triggering of thunderstorms can be also different. At the elaboration of the Storm Warning System operated by the Hungarian Meteorological Service these local effects should be considered. The purpose of this study is to improve our knowledge about these local effects to increase the reliability of storm warning system.

Lake Balaton can impact the atmosphere locally in several ways. The most significant effect is the difference of temperature between the lake surface and the surrounding surfaces, generating the lake circulation system. Due to the larger heat capacity of the water, the vertical profiles of temperature is different over Lake Balaton and over the surrounding region. This effect can significantly modify the local wind in different ways at daytime and at nighttime. As an open water surface the lower friction can result higher wind speeds. Even more the Bakony mountains can generate orographic waves, which can also influence the wind field.

On the southern side of Bakony Mountains a downslope windstorm can develop: (i) if the large scale flow is northwesterly, thereby perpendicular to the mountain range; and (ii) if the vertical profiles of temperature and wind are also suitable. Generally this wind is not be as severe as bora in Croatia, but can induce an announcement by the warning system.

In the research the WRF (Weather Research and Forecasting) numerical weather prediction model has been used to study how the Bakony mountains impact the weather at Lake Balaton if strong synoptic northwesterly flow occurs on the backside of cyclones. The model results reveal similarities between bora and the down slope wind generated by Bakony. This result has been confirmed by data observed at meteorological stations, and in pictures produced by satellites and radars and timelapse videos. We have proved, that downslope windstorms could be generated by mountains lower than 1 km at suitable atmospheric conditions.

## TITLE

**DETERIORATING WATER BALANCE - WATER TRANSFER AS LAST RESORT TO SAVE LAKES**

## AUTHOR(S)

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The natural water balance of extremely shallow Lake Balaton shows a statistically significant trend of deterioration and became negative in 9 out of the recent 23 years. Serious drop of water level has been experienced in the years from 2000 to 2003 and 2011 to 2012. In addition to the regional economic perils that had already emerged and may emerge again and/or may become permanent, the ecological system of the lake is also under stress in such periods. Loss of spawning/reproduction areas and surfaces; mass growth of filamentous green algae *Cladophora glomerata* in shallow waters; higher water temperature; higher growth rates of organisms and more intensive sediment resuspension and mass transfer; increase in dissolved salt concentration; growth of weeds, shrub and trees in the littoral zone instead of reeds; growth of algae mats on the surface of the sediment because of more favourable light conditions; advance of reed into the open water surface; proliferation of submerged vegetation and occurrence of harmful algal bloom events may have serious negative impact on the ecosystem. In order to maintain a "sufficient" lake level water transfer from other watersheds was considered as early as two decades ago. Projections of climate change impacts on lake water quantity and recent, largely unexpected, reemergent water quality problems put water transfer as a pressing issue on the table again. Water transfer into other lakes has long been used for various purposes without severe ecological consequences. Therefore, it can be considered as a serious option in saving Lake Balaton in the present form and size. Based on the available water resources, there are several options to bring water into Lake Balaton. However, chemical and biological water quality of "donor" water bodies should be carefully evaluated before serious decision would be made. Potential sources of water transfer are reviewed taking into consideration water resources availability, water quality and expected cost estimates involved.

## TITLE

## CORRELATIONAL ANALYSES AMID COOCCURRENCE PATTERNS, FUNCTIONAL ECOLOGY AND FUNCTIONAL TRAITS OF THE NONMARINE OSTRACODA (CRUSTACEA)

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Ostracods can be found in a variety of different aquatic habitats from deep ocean (>5000 m) to the mountain lakes (>5000 m). Such a broad geographical distribution can be related to a wide tolerance level of the individual species to different ecological factors. It is probable that each species has its own species-specific habitat preferences where species bear unique morphological characteristics to increase their survival chances. Also, it is known that some species pairs (or groups of species) tend to occur together due to their common functional traits. Although such information is important, studies on the relationships between ostracods functional ecology and functional traits are not common. To investigate such relationships, 101 different aquatic habitats were randomly sampled during 18-22 August 2023. Total of 20 species were collected from 48 sites. Seventeen species are new report for the province. Cooccurrence analyses displayed random occurrences of 15 species pairs. Among them, five are the most common species with cosmopolitan (or cosmoecious) characteristics. Accordingly, we found a negative relationship between ecological tolerance and optimum estimates (requirements) of those cosmoecious species, who have relatively high ecological tolerance levels with wide geographical distribution. Contribution of these species to alpha species diversity ( $p < 0.05$ ) was more than 90%. Ternary plots showed that calcium was the dominant ion in the water bodies sampled where the species were found during the present study. Fundiversity analysis revealed better and meaningful results for the elevational range than water temperature. Thus, among the traits, length of swimming setae is correlated to high values of functional diversity, richness, and distribution of species among five elevational ranges. Numbers of species with swimming ability due to presences of natatory setae on the second antenna were significantly higher ( $p < 0.05$ ) in lentic water bodies (e.g., lakes, ponds) than those species without setae in lotic waters (e.g., creeks, rivers). Such a separation between the groups suggest that species adaptive values are evolutionary shaped; therefore, we estimate strong correlations between species functional ecology and those of functional traits.

## TITLE

## LAKE PRESERVES HUMANS: A CRITICAL CONSTRUCTIVE POSTHUMANIST DISCOURSE

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The nature-culture conflict has been one of the most debatable issues of human civilizations; however, after the European industrial revolution, almost all of the power inherited in nature has been hijacked by humans in general and developed countries in particular in the name of modernity and economic prosperity. The foundationalist model of education and neoliberal political and economic systems have been underpinned by corporate finances, which appeared to have arms with goodwill in a front pocket and control, management and manipulation in their back pockets for the continuous exploitation of nature, including lakes for making undue profit. The consequence is that we have faced the problem of sixth extinction. In this regard, we have some propelling questions. Who is responsible for depleting the wetland, lakes, ponds and glaciers? Whose interests are being served? Are lakes and ponds only objects for human manipulations to fulfil their materialistic desires? Against these backdrops, the major objective of the paper is to offer alternative discourse on lakes and human relations. In doing so, we decisively select five information-rich participants from the indigenous cultural groups, particularly Tharu and Bote communities. I deployed a narrative research design to explore the true essences of the relationship between the lake and human culture, which has been underpinned by interpretive, critical, postmodern, and integral paradigms. The required texts have been generated through in-depth interviews, formal and informal discussions and participant stories.

We used two broad theoretical constructs of criticalism and constructive posthumanism to interpret and make meanings from the field text. The critical constrictive lens enables us to raise questions about the taken-for-granted narratives constructed by humans for their pleasure and support to ensure the paradigm shift in thinking, doing and living. From the posthumanist perspective, lakes and other natural resources are not external to human beings. Metaphorically speaking, these are inherent components of human civilizations, like as heart and brain of the human body and also contribute to cognitive development and affective, sociocultural, ecological and spiritual sensibility.

We have captured the five themes from the analysis and interpretation of the field texts. Firstly, we develop empathic views towards the lakes that they are more than objects for human manipulations. Secondly, we incorporate the intrinsic values of lakes (social, cultural, religious, economic, etc.) and their ecosystems that preserve human civilizations. Thirdly, we challenge the egocentric approach and simultaneously revitalize the eco/zoo/nature justice notion of preservation. Fourthly, it is necessary to restore the hijacked roles of native communities who intrinsically worship nature without having the mindset of profitization to nurture human civilization and lakes. At last but not least, we need to liberate or emancipate our younger generations from the neoliberal political and economic system backed by ultra-rational, mechanistic and technocratic visions of corporate business houses whose motives are to earn money without due respect for natural-culture coexistence and codependence in the name of developing ecotourism.

## TITLE

**LAND USE CHANGES AND IMPACTS ON LAKE NAIVASHA**

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This GIS study examines 40 years of land use changes around Lake Naivasha, focusing on the floricultural industry, hotels, tourism, geothermal power, and urbanization. It spans from 1984 to February 2023. The research employs GIS analysis, water quality records, and biodiversity monitoring.

GIS technology is used to map and analyze the evolution of these sectors, providing visual insights into the changing landscape. Water records are scrutinized to assess how these developments have affected the lake's water quality. Additionally, biodiversity shifts are observed to understand ecological impacts.

The study aims to inform lake managers by offering data-backed recommendations. These recommendations will guide sustainable land use planning, environmental preservation efforts, and strategies to mitigate adverse effects on Lake Naivasha's ecosystem.

## TITLE

**COMPOSITION OF PLASTIC DEBRIS ALONG THE POPULAR TOURIST SITES OF ASIA'S LARGEST BRACKISH WATER LAKE ECOSYSTEM ON EAST COAST OF INDIA**

## AUTHOR(S)

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Plastic garbage pollution along the shoreline of aquatic ecosystems such as lakes, lagoons, estuaries and bays seems challenging to the aquatic life as well as to human health. Thus, in recent times, it becomes paramount research attention for the researchers and scientists. In connection to above rationale, present study was carried out in Chilika lake a designated RAMSAR site located along the east coast of India. Well known for its vast biodiversity, exploitable fishery resource and incredible scenic beauty Chilika attracts people around the globe. It is obvious that apart from untreated sewage, vast arrival of tourists become responsible for unconscious release of plastic debris. Quantifying such plastic debris along the shoreline of popular tourist destination of Chilika lake is a major concern. Hitherto, availability of relevant information in this concern is absolute meager. To bridge this existing knowledge gap, present study was designed amid of covid -19 pandemic that was executed in two stretches i.e. January to March (Pre Covid) and October to December (Post Covid) during 2019 & 2020 from three tourist sites namely Balugaon, Badkul and Kalijai temple Is. Quadrature method (1 m x 1 m) was applied to collect plastic debris and subjected to quantify with respect to their type & weight (gram/ m<sup>2</sup>). Obtained result deciphered that the shoreline of all the three study sites found regularly disturbed with plastic debris. However, the concentration of plastic at Kalijai cannot be underestimated from other two sites. A total of 72 different debris materials were identified during pre covid periods in lieu of post covid that accounted for 68 types at Balugaon, while in Badkul it was comprised with 70 and 68 types, but from Kalijai Is. obtained values were slightly less i.e. 65 and 61 types respectively. Corresponding to it, cumulative weight of the plastic followed the same trend i.e. Balugaon > Badkul > Kalijai. But, different plastic debris was dominant in different locations. Study also observed that, physical forcing such as wind and water current pattern responsible for rapid dispersion of debris from shoreline to water column and to sink later in bottom sediment. Plastic debris found buried within the sediment execute lethal threat to benthic organisms and those are in floating condition act problematic to fishes, birds, dolphins etc. In long term plastic debris exposed to water and sediment of Chilika lake sternly damages the ecosystem health, in turn, it can interfere with food web directly and becomes a major threat to human being. Pelagic organisms have mobile ability to avoid macro & mega category of marine plastic but cannot avoid micro-plastic and nano-plastic materials. Whereas, benthic organisms are forced to be the victim of all forms of plastic debris. Therefore, they become sentinel to rationalization of research promulgated due to such anthropogenic stress. Present finding necessitates a long term scientific study on aquatic biodiversity on lake ecosystem health with special attention to pelagic vis-à-vis benthic provinces to accumulate conclusive figure that could be helpful for implementing proper lake management practice with integrity.



## TITLE

**SMALL SIZE OF MICROPLASTICS IN WATERS OF INFLOWS AND LAKE BIWA, JAPAN**

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Microplastics (MPs) may have a negative impact on the aquatic ecosystems, and now there are numerous researches performed mainly in the ocean. MPs runoff from freshwater systems might have a serious impact on its ecosystems, so there is an increasing number of studies targeting these areas. An MPs survey was conducted in Lake Biwa in 2020 by the prefectural government, and the results of the survey of MPs in the lake water were released recently. Although a lot of plastic waste can be seen at the shore of the lake, a detailed survey of the current status of MPs especially smaller size (0.1 – 0.3 mm) of MPs on the waters of the north basin of Lake Biwa of North Basin was not conducted. We investigated the current status of these MPs in the waters of offshore and shores of Lake Biwa, and inflow rivers.

The survey was conducted at three locations in the north basin of Lake Biwa (pelagic T1: max. depth 90 m, nearshore close to the mouth of the Inukami River, and the intermediate location between two) and two locations at the mouth of rivers (the mouth of the Seri River and Usa River). Water samples of 90L (in Lake Biwa) and 5L (river estuary) were collected, and the MPs contained therein were counted manually. Water was sampled at a depth of 0.5m at each location, but MPs at T1 was sampled at depths of 2.5m and 5.0m also. A stereomicroscope was used for the analysis, and the color, shape, and major axis ( $\mu\text{m}$ ) of particles that could be MPs were recorded. To determine whether the sample was MPs or not, the sample was stained with Nile Red, and the filter of the Seri River estuarine sample was observed using a fluorescence microscope. Comparing three locations in Lake Biwa and two locations at the river mouth, the river mouth sample had more MPs per unit volume of water. In Lake Biwa, more MPs were observed from offshore to nearer the shore. Concerning MPs at T1, the number was higher at shallower water depths.

Looking at the color and shape ratios, many blue fibrous particles and white and transparent fragment-like particles were observed. Although it was confirmed by the Nile Red staining method that the white and transparent fragment-like particles were likely to be MPs, it was confirmed that the blue fibrous particles were probably not MPs. Since more MPs were found in river estuary samples than in Lake Biwa samples, rivers are considered to be the main source of MPs runoff. It is thought that the fragmented particles mainly flow into Lake Biwa from rivers, and after flowing into Lake Biwa, they tend to disperse (PP & PE) or settle offshore (PET, PC & PFA). Furthermore, if the fragmented particles are assumed to be PP, it is thought that they originate from films used in food containers and food packaging. It is thought to be effective to focus MPs measures on rivers and promote waste collection from riverbanks.

## TITLE

**TOURISM DESTINATION MANAGEMENT MODEL TO PROTECT AQUATIC HABITATS AND THE CULTURAL HERITAGE IN THE TOKAJ WINE REGION IN HUNGARY**

## AUTHOR(S)

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The Tokaj World Heritage Wine Region is not only famous for its wines but is also one of Hungary's most beautiful cultural areas, rich in surface waters, rivers, several small lakes, and cut-off riverbeds. The region's agriculture, especially viticulture, and the natural beauty of its landscape offer a wide range of unique tourist attractions. Although tourism could bring a significant economic boost to the region, the impact of these activities on the environment, particularly forests, wetlands, small shallow fishing lakes and floodplains must be assessed to ensure the sustainable use of these natural resources. The catchment of Bodrog river is the only area in Hungary that is regularly flooded, and it was included in the 1989 list of Ramsar international sites as a waterbird habitat of high importance. At least twice a year (late winter and early summer), and sometimes several times a year, the thousands of hectares of the Bodrogzug, where the rivers Tisza and Bodrog meet, are flooded. There is a succession of marshy patches, boggy meadows, and marshes, willow-woodland, and floodplain forests. The marshy areas are characterised by reed beds and tallgrass communities, and the water of the marshland lakes contain rich communities of seaweed. According to the Water Framework Directive, 'good status' means not only the purity of water, but also the minimum disturbance to aquatic habitats and the availability of sufficient water. The environmental status of water catchments, the pressures on water bodies from diffuse pollution, and the estimation of runoff and infiltration from, inter alia, precipitation, the type and scale of land use shall be taken into consideration. This of course includes the water needs of agricultural areas and the use of surface waters as a tourist destination. The environmental impact in terms of water pollution and disturbance of habitats is considerable, enhanced by the adverse effects of climate change. Therefore, the ecological carrying capacity of these environments must be the guiding principle of tourism destination development and management. Furthermore, the valuable built heritage of Tokaj, the historic wine cellars, manor houses and settlement structures must also be an essential part of the conservation projects, not only because of their cultural value, but also their potential for small and medium scale organic wine production, perfectly suitable to reduce the environmental impacts of agriculture and, from a tourism development perspective, all of them are or can be tourism destinations. The sustainable tourist destination development strategies require a complex system approach, where agricultural production and agritourism, tourism product development and marketing, designing tourism product packages, infrastructural development and heritage conservation are treated as integral parts of the same system. Here a new wine tourism destination management model is proposed, based on multifunctional organic agriculture where circular economy, nature and culture conservation together will guarantee the continuity of a resilient regional development.

## TITLE

**ENVIRONMENTAL MANAGEMENT OF ECOSYSTEMS OF LAKES AND THEIR CATCHMENT AREAS THROUGH LANDSCAPE OBSERVATORIES**

## AUTHOR(S)

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Landscape observatories, multifunctional platforms and knowledge centres for researchers, technicians, administrators, and citizens, are one of the Council of Europe's instruments for implementing the European Landscape Convention (ELC). The environmental pressure from urban, peri-urban and semi-rural development and development of tourism infrastructure in both urban and rural areas is strong and increasing, which is adversely affecting the various ecosystem services such as biodiversity, flood control and water resources, soil quality, aesthetic values, and the capacity to cope with climate change. Lakes and their catchment areas, associated wetlands, and the aquatic habitats are precious but vulnerable resources, where the prediction of the impact of construction activities and changes of land use on organisms and habitat functions, and if necessary, the regeneration or reestablishment of ecosystem health is a prerequisite for resilient nature conservation. It is important to emphasize, that the tourism industry is one of the most intensive users of ecosystem services, which is particularly pronounced in areas of high ecological sensitivity such as wetlands and the coastal zones of shallow lakes. Therefore, while planning tourism destination development, the environmental, cultural, and economic carrying capacity of ecosystems of the target locations must be assessed. Landscape observatories are ideal organizations for integrating both nature and cultural environment interests to achieve good ecological status in lakes and rivers and at the same time achieve a balance in the relationship between natural and cultural environment values and the recreational values in these areas. Landscape observatories can play a key role as decision support instruments in promoting sustainable landscape development and nature conservation through a regenerative approach. Furthermore, to perform effectively and efficiently their mission, landscape observatories must make specific and unavoidable reference to the territorial characteristics of the regions for which they are created. We propose a comprehensive and holistic, to any landscape type adaptable landscape observatory concept, in this case adapted for environmental management of lakes and their catchment areas, based on the inherent multifunctionality of these institutions, emphasizing their decision support roles, environmental, social, and economic importance.

## TITLE

**MANAGING URBAN LAKE AND WETLAND FOR SUSTAINABLE USE: PUTRAJAYA EXPERIENCE**

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In the planning and development of the city of Putrajaya, the city planners have turned to nature for inspiration, resulting in an urban landscape dominated by the scenic Putrajaya Lake. The constructed lake primarily designed and developed to be used for water sports and recreational activities as well as for tourist attraction. To realize this vision, a high standard of lake water quality must be ensured, and the solution was found with the construction of 200 ha of Putrajaya Wetland. The wetland provides the opportunities of incorporating a unique ecosystem into urban area to ensure sustainable city development especially in the treatment of catchment runoffs. Additionally, the wetland helps in flood mitigation, serves as breeding grounds, nurseries and homes to numerous flora and fauna. It has also become an important site in raising awareness and educating the public especially for school children. Over the years, the 400 hectares Putrajaya Lake has served as an important center for many international water sport activities starting from the F1 Powerboat World Championship in 2004, the 2005 Asian Canoeing Championship followed by the Red Bull Air Races in 2014 and the SEA Games - 29 in 2017. On the other hand, its 38 km foreshores also form Putrajaya's most popular resource for informal recreation as a waterfront city. Putrajaya Lake and Wetland also provides opportunities of the ecologically and environmentally orientated recreation pursuits. Moreover, it grants plenty of opportunity for education and research and regarded as a reference point for one for one of the best managed lake ecosystems in this region. Above and beyond, it creates a conducive environment for residents to live, work and play. Being a man-made water body in an urban setting, the management of the physical as well as the human issues within the catchment is crucial. The success of the Management of Putrajaya Lake and Wetland depends largely on the cooperation and coordination between the stakeholders (landowners), government agencies, the local authorities involved and the public at large.

## TITLE

## CHALLENGES OF THE WATER ENVIRONMENT IN JAPANESE LAKES AND THE TREND OF WATER QUALITY CONSERVATION MANAGEMENT EFFORTS AND ENVIRONMENTAL POLICIES

## AUTHOR(S)

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Ministry of the Environment

In Japan, environmental administration related to environmental laws, including their system and content, has progressed in response to the occurrence of pollution and environmental issues. As a result, water quality conservation in Japanese public waters has been supported by various measures, including the regulation of wastewater discharged from specific industrial facilities into public waters based on the Water Pollution Control Law, as well as the development of sewage systems and wastewater treatment facilities such as septic tanks. Additionally, legal measures have been taken to address eutrophication-related issues such as blue-green algae (Aoko) and freshwater red tides in lakes.

Furthermore, efforts have been made to conserve the lakeside environment, including the preservation of vegetation and aquatic organisms in lakeside areas, in order to maintain and restore a healthy ecosystem.

Despite these efforts, the achievement rates of environmental standards related to the preservation of the living environment, particularly the environmental standards for BOD (Biochemical Oxygen Demand) or COD (Chemical Oxygen Demand), which are representative water quality indicators for organic pollution, are as follows: 93.1% for rivers, 78.6% for coastal areas, and still a low 53.6% for lakes.

In lakes, despite a decreasing trend in the inflow of pollutants due to past water quality conservation measures, the levels of COD have remained high, and issues such as the occurrence of blue-green algae (Aoko) and a decline in native fish and aquatic species persist. Furthermore, in recent years, new challenges related to changes in the water environment of lakes have been identified, including issues like substance cycling, abnormal proliferation of phytoplankton, and a decrease in dissolved oxygen levels in the bottom layer. These challenges are strongly associated with concerns about climate change.

Taking these circumstances into account, the Ministry of the Environment has undertaken various studies and initiatives related to the conservation and management of water quality in lakes.

Furthermore, taking into account the impacts of climate change and changes in ecosystems, in addition to the traditional approach to lake water quality conservation, which focuses on reducing pollutant inflow to improve water quality within the lakes, a new approach has been considered. This new approach aims to manage water quality by facilitating substance cycling not only for water quality preservation but also for the conservation of aquatic resources. Additionally, comprehensive water environment management efforts are being explored to contribute not only to water quality management but also to the preservation of biodiversity and regional development.

In this report, we will introduce the discussions and initiatives carried out by the Ministry of the Environment regarding lake water quality conservation, as well as the ongoing considerations for new approaches to water quality management and the trends in environmental policies.

## TITLE

## THE POTENTIAL ATTRACTION OF ELECTRIC SURF, FOILS AND SUPS IN THE TOURISM OF SMALLER HUNGARIAN MINING LAKES

## AUTHOR(S)

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In Hungary, there are many small mining lakes in Borsod County, which are currently mainly used for gravel mining. These lakes have also been used for sailing, bathing and fishing in recent times. However, in terms of tourism, these lakes and the surrounding villages still have great potential.

The water of these lakes is clean, they contain few plants on the open water surface, and the water surface of the lakes is mostly undulating and they deepen quickly. These properties make them ideal for the use of the latest water sports equipment that requires technical skills, which are being used more and more successfully around the world. In fact, new sports have been created using these devices. In Hungary, these sports are only available on Lake Balaton and Lake Velence, but these lakes are not ideal for these sports.

This year, we plan to launch a new green sports center on Lake Mályi and the Nyéki lake system. Electric surfboards and electric foils have been purchased and we will soon start teaching these sports for both children and adults. We also plan to organize regional and national competitions. Our goal is also summer training camps for professional winter sportmen. These devices use electrical energy, they do not increase the pollution of the lakes, but they can generate a very fast development of demanding rural tourism with additional programs around the lake.

## TITLE

**NEW CLINICAL OPPORTUNITIES AND NEW CLINICAL EVIDENCE IN BALNEOLOGY**

## AUTHOR(S)

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Hungary is one of the richest countries in thermal waters. In the field of green energy, we can also attribute an increasing role to the thermal energy of thermal waters. Medicinal waters used for medicinal purposes were previously released into lakes in our country. Due to the high content of ions and trace elements, their introduction into natural waters (lakes and rivers) can be considered environmental pollution. In our presentation, we will analyze what procedures must be used so that the medicinal waters remaining on the surface can be discharged into lakes without causing any harmful effects.

In the field of balneology, many new preclinical and clinical research concepts and results have seen the light of day in the past period. Ancient bacteria were isolated from Hungarian thermal waters, whose DNA and life functions show many differences from bacteria living on the earth's surface. For a long time, the beneficial clinical effects of medicinal waters were explained by the content of ions and trace elements in these waters and their absorption into the body. According to the latest research, the macromolecules and proteins of thermal waters also play an important role in pain-relieving and anti-inflammatory effects. Medicinal waters probably have a beneficial effect not only on the human body in a direct way, but also on the bacterial microbiome on the surface of our skin, and thus they can also exert a beneficial effect indirectly.

In our presentation, in addition to the latest evidence, we will also present our own 4 research results.

- (1) Neutralization of harmful substances in medicinal waters before they enter lakes.
- (2) We present the results of our pilot complex clinical study investigating the absorption of ions and trace elements of 5 Hungarian healing waters.
- (3) For the first time in the world, we performed balneological treatment combined with an art performance for a terminally ill cancer patient.
- (4) We have developed a weight bath cabin complete with a vibration system. With this, the safest and most effective traction treatment can be performed anywhere in the world.

## TITLE

**EFFORTS TO FOSTER THE MOMENTUM AND NEXT GENERATION REGARDING CONSERVATION AND RESTORATION OF LAKE BIWA IN SHIGA PREFECTURE, JAPAN**

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Shiga Prefecture is home to Lake Biwa, the largest lake in Japan. The water of Lake Biwa supplies not only Shiga, but also Kyoto, Osaka, and Hyogo, to support the daily lives of 14.5 million people and industry across the greater Kansai region. Lake Biwa is also valued as a treasure trove of diverse ecosystems. People living in Shiga have been connected to Lake Biwa since ancient times, reaping the rich bounty of its waters, and living in harmony with the forces of nature.

However, in 1977, the first major bloom of freshwater red tide occurred in Lake Biwa. After synthetic detergents containing phosphorus were identified as the main cause, a social movement known as the Soap Movement spread across Shiga, primarily among housewives, and called for residents to "use powder soap and avoid using synthetic detergents."

As a result of this movement, Shiga enacted the Eutrophication Prevention Ordinance in 1979 to regulate phosphorus. Thanks to reduction of inflow load, blooms of red tide have been successfully suppressed.

A prefectural assembly was held in 1980 to commemorate the enactment of the ordinance, and July 1, the day the ordinance went into effect, was designated "Lake Biwa Day" on that occasion. Lake Biwa Day has become a symbolic day for the citizens of the prefecture to share their feelings toward Lake Biwa and protect the environment, as cleanup activities are held throughout the prefecture every year.

The efforts to raise awareness of the importance of local lakes and water resources through the establishment of such a commemorative day may be shared with the "Great Lakes and Freshwater Week" in Michigan, the United States, which is a sister and friendship state of Shiga Prefecture.

Shiga Prefectural Government has also made efforts to foster the next generation in order to promote the conservation and restoration of Lake Biwa and to develop future water managers, leaders, and decision makers. Shiga Prefecture has formulated a promotion plan based on the "Shiga Prefecture Ordinance on the Promotion of Environmental Learning" and has been working to "create a sustainable society in which "life" is linked by fostering people who love their community and can act on their own.

A typical example is the "Lake Biwa Floating School Project. The Lake Biwa Floating School Project is a learning program in which all fifth-grade students in Shiga Prefecture board the Uminoko, an environmental learning ship, and spend one night on the ship to learn about Lake Biwa and its surrounding environment. This program has been in operation since 1983, and more than 600,000 students (equivalent to about half of the population of Shiga Prefecture) have boarded the ship in the 40 years through 2022.

In addition, in 2021, Mother Lake Goals (MLGs) were established as SDGs for Lake Biwa. These 13 goals are themed around the lake, and promote activities by prefectural residents to protect the Lake Biwa environment, thereby helping to achieve the SDGs.

## TITLE

**SAVING ENDORHEIC AND SEMI-ENDORHEIC LAKES THROUGH INNOVATIVE SYSTEM SOLUTIONS**

## AUTHOR(S)

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Endorheic lakes have no outflow to other waters, their water level is dependent on inflow and evaporation or seepage, while semi-endorheic lakes have only limited, and often artificially regulated outflow to other water bodies. The ecosystems of shallow endorheic and semi-endorheic lakes are very sensitive where the key factors of their continued existence include the management of water level fluctuations, maintenance of good water quality, ecosystem health and biodiversity, the mitigation of the adverse effects of climate change and the environmental and socio-economic sustainability of human activities. These lakes have relatively long retention times, and can trap pollutants for extended periods, which is often enhanced by sediment accumulation. The Vollenweider report, which looked specifically at the relationship between eutrophication of lakes and human activity, highlighted that these effects are even more pronounced in shallow lakes. Although regulations have been put in place in many areas to mitigate these adverse effects and attempts are being made to limit and manage climate exposure through the construction of reservoirs, a coherent systems approach that takes into consideration the finite nature of ecosystem services in regional development and tourism destination management is lacking in many areas. Furthermore, environmental disasters, such as fish death can occur in shallow endorheic lakes more often than in larger and deeper water bodies and exorheic basins. In addition to pollution and eutrophication, the main cause of fish mortality in shallow lakes is the development of an oxygen-depleted environment and an increase in ammonia concentration in some parts of the lake due to extremely warm weather, drought and high evaporation causing low water levels, for which aeration is only a temporary and incomplete solution. Non-intervention is no longer sufficient, but a regenerative approach is needed, where the main task is to maintain and reconstruct lake and wetland ecosystems by improving the extent and quality of certain priority habitat types, preserving, and restoring the habitats of protected plant and animal species occurring in lakes and lake areas and developing multifunctional water management systems. This true, innovative multifunctionality includes the continuous monitoring of environmental status (even recording the occurrence of invasive species), ecological maintenance (e. g. dredging, aeration, sustainable water level regulations, vegetation control, liming of acid lakes where and when appropriate, etc.), and adaptation of good practices through a strong social network based on participatory approach and adaptive co-management enhancing the social capacity of a region to respond to unpredictable changes creating a resilient social-ecological system.

## TITLE

**SUSTAINABLE BIODIVERSITY CONSERVATION THROUGH INTEGRATED LAKE BASIN MANAGEMENT (ILBM) APPROACH IN NEPAL-KUPINDE DAHA, SALYAN**

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Kupinde Daha is a remarkable freshwater lake located in the Salyan district of Nepal. Situated in the mid-hill region of the Indo-Malayan biogeographic realm, it boasts a diverse ecological character, supported by its lake, surrounding forests, and interactions with local communities. The lake itself, with an area of 4.2 square kilometers and an average depth of 69 meters, provides a habitat for various fish species, amphibians, and invertebrates. It is in the mid-hill of the Indo-Malayan biogeographic region having a hot monsoon and sub-tropical climate. The geology of the lake and its surroundings consist of limestone (thin to thick-bedded, grey, blue, and black, fine-grained, dense), marly limestone, calcareous schists and dark grey to black shales (M. R. Dhital, 2015). The lake is fed by the natural spring which originates inside the lake while rainfall and flood in the monsoon season is another source of water. The surrounding natural Sal forests harbor a rich array of flora and fauna, including notable species such as *Shorea robusta*, *Juglans regia*, *Martes flavigula*, and *Lophura leucomelanos*. The diverse avifauna, with species like *Psittacula kramera* and *Tyto alba*, makes Kupinde Daha an important site for bird watching.

The wetland serves critical ecological functions, such as nutrient cycling, water regulation, and habitat provision. It supports local communities by providing drinking water for livestock and biodiversity, as well as irrigation services for paddy cultivation in nearby villages. Moreover, Kupinde Daha is a popular destination for recreational, educational, and religious purposes, with the presence of the Barahadev Temple attracting devotees twice a year. However, Kupinde Daha faces challenges due to changing climatic conditions, impacting phenology, wildlife habitats, and the overall hydrological regime. The involvement of local communities and indigenous peoples is crucial in maintaining the ecological balance and preserving the wetland's biodiversity. Their traditional knowledge, practices, and voluntary efforts contribute to the sustainable management of the wetland, ensuring its cleanliness, conservation, and protection from pollution.

This is a ten-year study guiding document prepared through rigorous processes from intensive consultation among environmental institution, government bodies and district authorities followed by socio-ecological studies and community workshop. Penultimate product of such processes was fully discussed and endorsed by local level consultation including local government. This prescription empowers local communities and institution to harmonize Lake Environment and biodiversity, and helps those maximizing sustainable benefits from lake management. This study proves that Integrated Lake Basin Management (ILBM) is the best tool to improve Lake Basin governance on integrating issues of lakes.

## TITLE

## A STUDY ON DECADAL CHANGES IN WATER QUALITY OF BHOJ WETLAND, THE CENTRAL INDIAN RAMSAR WITH RESPECT TO RAPID URBANIZATION

## AUTHOR(S)

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Bhoj Wetland, one of the most important Central Indian Ramsar Sites is providing multiple services viz. drinking, fisheries, irrigation, ecotourism etc. to a population of about 2.5 million people living in Bhopal, the capital city of Madhya Pradesh. The wetland constructed in 10 century by famous King, Raja Bhoj is arguably the oldest existing manmade wetland in India. The wetland is enriched with more than 700 species of various categories of flora and fauna besides being an Important Bird Site (IBA) habitating more than 20000 avian species including residential and migratory visitors.

However, the inevitable process of urbanization especially in last four decades resulted in deterioration of overall water quality, subsequently posing a threat on ecological sustainability of this pristine wetland. Since this wetland is intimately related with the livelihood of the people of Bhopal city and is also an important water body due to its socio-economic, cultural and religious values, therefore a major conservation and management programme was implemented by the State government with the support of Government of India through external funding from JBIC, Japan. Various conservation measures like interception, diversion and treatment of sewage, solid waste management, catchment management through construction of check dams, plantation, fisheries development and other engineering interventions like desilting, dredging etc were implemented during 1998-2004 for improving the water quality and biodiversity of the wetland. Implementation of the identified conservation measures resulted in significant improvement of water quality of the wetland in post project implementation phase i.e. during 2004 onwards (Annual Report, 2004, ERL, EPCO).

Since this wetland is an important Ramsar site hence monitoring of water quality of the wetland is being continued since 1998. For this purpose water, soil and biological samples are being collected from 18 sampling stations at monthly interval and are being analysed for various physico-chemical and biological parameters.

The comprehensive study over 20 years has shown that the water quality of the wetland at present is fairly good as various indicating parameters like pH, BOD, COD are well within the permissible limits nevertheless variations in few parameters have been observed at instances at different stations due to temporal and seasonal influences and other natural variables. The details of 20 years study are presented in the paper.

## TITLE

## THE IMPACT OF CLIMATE CHANGE ON MOUNTAIN LAKES AND THEIR ECOSYSTEMS IN THE CARPATHIANS - MITIGATION MEASURES

## AUTHOR(S)

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Mountain lake ecosystem services include source of water, food and energy, tourism and recreation opportunities, and they have great aesthetic and spiritual value. The largest and deepest lakes in the Tatras are located on the northern side of the mountain range, in the Polish Tatras, as the largest glaciers were once formed on the northern side of the mountain range, such as Morskie Oko (34.93 ha), Wielki Staw Polski (34.35 ha) and Czarny Staw pod Rysami (20.64 ha). It is widely accepted that the ecosystems of mostly isolated mountain lakes, watercourses and wetlands are generally less damaged by human activities than other habitats. However, climate change, global and local anthropogenic activities such as water abstraction, introduction of alien species and atmospheric transport of pollutants over medium and long distances can have adverse effects on their natural state. In addition, excessive tourism and intensified upland farming are two other major sources of organic pollutants that can threaten local aquatic biodiversity. Surface and groundwater, grasslands, wetlands, forests and the economic services that rely on them (e.g., forestry, tourism, agriculture) in the Carpathian region are particularly vulnerable to the expected impacts of climate change. Over the past two decades, glacial retreat and snow cover developments have led to changes in the timing and amount of runoff in many mountain regions. Groundwater can provide some resilience to the loss of meltwater in the short term, but this recharge is expected to decrease in the long term. Based on climate model results, an average annual temperature increase of 1.3-1.5°C is projected in the southern Carpathians by 2050. Over the next three and a half decades, precipitation is expected to decrease by 20-70 mm per year, depending on the location within the Carpathians. At the same time, floods, landslides, and debris flows caused by uneven rainfall distribution and periodic surges of large amounts of water are causing major natural disasters. Other projected impacts of climate change include a reduction in winter tourism, lower energy potential of mountain hydropower, changes in vegetation zones and a significant loss of biodiversity. In addition to wetlands, plant and animal species living near mountain peaks are also at risk of extinction as they are unable to migrate upwards. We need to focus on ecological monitoring of threatened ecosystems, identification and measurement of environmental pressures (e.g., introduction of alien species, environmental contaminants) and the use of bioindicators/tracers to develop appropriate and flexible management strategies. If the global warming rate exceeds 1.5 degrees Celsius, the adaptation needed to manage the main risks will become increasingly urgent in mountain areas. The speed and depth of current adaptation will not be effective enough to manage future risks, especially in the event of a larger global temperature increase. Nature-based solutions can be particularly good because they improve living conditions alongside mitigation. It is important to protect existing forests and restore degraded areas, preserving local flora and fauna. In agriculture, diversification of livelihoods, climate-smart agriculture or agroforestry and protection of riparian zones can be effective solutions.

## TITLE

**TRADITIONAL IRRIGATION ECOSYSTEM MANAGEMENT THROUGH TANK WATER SUPPLY IN SRI LANKA**

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Sri Lanka is one of the few countries in the world that has had a thriving and vibrant ancient irrigation based civilization for over two thousand years. The cascade Ecosystem, they used for traditional organic cultivation of paddy, harmonized environment and development in an environmentally sound and sustainable manner. Upper catchment of the tank cascade system located in the forestry area and its play one of the most important role in the ecosystem. The forest cover in the catchment was community owned and was protected by controlling felling trees and clearing for agricultural expansion. The environmental services provided by the forest were valued in farming communities and used only for the sustainable extraction of some non timber forest products such as medicinal herbs for local medicinal preparations. The study was conducted in the Horivila cascade ecosystem in North Central province of Sri Lanka to identify current sustainability of tank cascade system. The main objective of the study was focused on identify the upper catchment forestry areas role on cascade. The study revealed that the environmental services provided by the forest were valued in farming communities and used only for the sustainable extraction of some non timber forest products such as medicinal herbs for local medicinal preparations. The study identified most of the tanks were abandoned or neglected and due to that elephants and other animals are leaving the forestry areas for water and food. Accordingly the increased elephant - human conflicts in the study area.

## TITLE

**NEPAL'S IMPLEMENTATION STATUS OF THE RAMSAR PROVISION**

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This paper evaluates the implementation status of Ramsar provision in Nepal by examining all 47 key actions under 15 strategies and 5 objectives of the National Ramsar Strategy and Action Plan-2018/24 (NRSAP). Three sets of self-evaluation matrices were prepared and validated. The 1st matrix evaluated Ramsar provision in Nepal with reference to key actions, strategies, and objectives of the NRSAP by adopting 'Done' or 'Partially Done' or 'Undone' approaches, all numerically expressible in '1'. Similarly, the 2nd matrix evaluated the 'Status of Capacity' and its 'Impacts' by responding to 23 questions related to enabling environment, existing operational apparatus, human resources development and managerial system, and resource allocation and mobilization. The 3rd matrix evaluated wetlands governance by applying a modification of the Governance Diagnosis System tool.

The evaluation team organized direct observations, sequential meetings, and independent consultations among diverse group of respondents (N=24). Data were processed, report was shared/discussed in a national workshop, and then the report was disclosed.

In 51 years of the Ramsar journey, Nepal has significantly responded Convention which fortified 10 Ramsar sites with a cumulative cover of 101,283 hectares accounting for about 0.7 percent of Nepal's total land. Nepal contributes substantially by 0.04 percent to the existing global Ramsar network. There is good progress in terms of institutional and policy responses, and governance is polycentric. Department of National Parks and Wildlife Conservation and Department of Forest and Soil Conservation are entities to coordinate the overall processes of Ramsar provisions with subsidiary roles of National Lake Conservation and Development Committee at center and Lake Conservation and Development Authority/Gandaki Province. Over 2 dozen of regulatory instruments cross-cut wetlands having National Wetland Policy and NRSAP, the most proactive wetlands documents, though no single act for wetlands. Other agencies have their regulatory measures which recognize wetlands contrarily, with an impression that wetlands are neglected, overlooked, and misunderstood. Wetlands are awaiting long for their recognition as ecosystem and integral 'development factor'.

There is a nominal progress of a 7 percent gain of achieved targets while pursuing NRSAP. 1st objective 'effectiveness of conserving and managing Ramsar network' is to enlist 10 new wetlands and increase wetlands coverage, which is not yet done. There is little progress toward 10 percent of targets achieved under 2nd objective 'wise use of managing Ramsar and other wetlands' by featuring wetlands at federal, provincial and local policies, mainstreaming wise use principles have remained as the major challenges that Nepal should adopt appropriate measures soon. Similarly, there is a nominal progress of about 6 percent of targets achieved under 3rd objective of 'capacitating federal & local stakeholders', which indicates the need for networking of wetlands. The present efforts of securing resources from national/international cooperation under 4th objective have a fairly low performance of 5 percent. Annual fund of government agencies is inadequate to deliver targets of NRSAP that demand USD 10.81 million. Overall in-house capacity of agencies to implement NRSAP is weak. All agencies have an average governance score below '30' which does not qualify for good wetlands governance.

The evaluation recommends Nepal for mid-term review of NRSAP, and delegate specific key actions to agencies and conservation partners to improve statistics of targets. The government needs to opt urgently to consolidate the Ramsar implementation mechanism having the national network of Ramsar sites and other wetlands with operational guidelines and action plans as one of the strategic mechanisms.

## TITLE

## FORMATION OF CARBONATE MINERALS AND PHOSPHORUS-RICH NANOPARTICLES IN ASSOCIATION WITH ALGAL BLOOMS IN LAKE BALATON

## AUTHOR(S)

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Minerals of the sediments of shallow lakes play important roles in the cycling of nutrients. In Lake Balaton, the release of sediment-bound phosphorus (P) is thought to trigger blooms of harmful cyanobacteria and other algal species. In order to understand the movement of P between sediment minerals and microorganisms, we used electron microscopy to study the nanoscale processes of mineral formation and transformation in association with algal blooms. We studied samples obtained from the lake, as well as products of laboratory experiments that simulated certain aspects of processes observed in the lake. Such processes included the precipitation and subsequent transformations of carbonate minerals, as well as the formation of P-rich nanoparticles.

Concerning carbonate formation, we observed the precipitation of amorphous calcium carbonate (ACC) in the immediate vicinity of photosynthesizing cells. ACC then transformed through dissolution and reprecipitation into aragonite which, in turn, converted to Mg-bearing calcite particles. The entire process appears to take place within hours to days; thus, the typical Lake Balaton sediment contains only Mg-bearing calcite particles. Carbonate precipitation is thought to provide a sink for P (by its adsorption on the mineral surface); however, the multistep process of carbonate formation that involves dissolution and reprecipitation cycles certainly complicates the understanding of the fate of adsorbed species, including that of P.

We identified P-rich nanoparticles both in association with algal blooms and in the sediment. Polyphosphate inclusions were abundant in cells of various cyanobacteria collected from a bloom in the Keszthely Basin in 2020. Remarkably, outside but next to the cells similar P-rich particles occurred but with slightly different compositions. On the other hand, lake sediments typically contained P-rich particles adhered to clay minerals, ranging in structure from amorphous to that of apatite. By comparing natural specimens with results of experiments with algal cultures, a sequence of transformation of biogenic polyphosphate inclusions can be identified: upon cell lysis, polyphosphate particles are liberated from cells and exposed to lakewater. Then these P-rich particles may be partly hydrolyzed (making their P content again available for microorganisms), and partly captured by the surfaces of clay minerals (and then permanently stored as apatite in the sediment). Thus, biogenic P-rich nanoparticles may be important and hitherto unrecognized components of the P cycle in lakes.

## TITLE

## THE USE OF GPS TRANSMITTERS IN REVEALING MOVEMENT PATTERNS AND HABITAT USE OF GREAT CORMORANTS AT LAKE BALATON, HUNGARY

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Conflict between cormorants and fisheries represents the challenges of sustainable natural resource management in the light of biodiversity conservation. The last few decades' considerable increase in the worldwide Great Cormorant (*Phalacrocorax carbo*) population along with climate change's impact on migration patterns of European populations emphasizes the need for detailed movement data for the species. Such data may be crucial for stakeholders to prioritize management goals and thus help decision making. Inland fisheries may be perceived particularly affected, however many inland breeding populations have experienced a moderate decline likely caused by population control measures raising conservation questions. In the Carpathian Basin for example, such changes have been documented in the last decade. To understand habitat use, and general movement patterns, we deployed GPS-GSM transmitters on 28 Great Cormorants (5 adults and 23 fledglings) in a breeding population between 2021 and 2023 at Lake Balaton, Hungary. Up to now, transmitters have provided more than 300.000 GPS positions. Our preliminary results show diverse movement patterns within the population in habitat use and in migration as well. Some birds remained in the relative vicinity of the breeding area whole year round, whereas other birds moved as far as Northern Italy. Similarly, movement data suggests that while some individuals prefer to forage on fishponds extensively, others choose natural and semi-natural habitats, for example riverine ecosystems, which should raise awareness of implementing best practice management principles. A considerable proportion of transmitters ceased to deliver movement data in a short period of time after deployment; only three transmitters provided data for more than a year. According to the GPS data and field observations, death of the birds could be assumed in most cases when transmission ended, and in the vast majority of these instances, shooting was the most probable and in several cases proved cause of death.



## TITLE

## RISING WATER LEVELS IN LAKE NAKURU, KENYA AND THE ROLE OF INTEGRATED LAKE BASIN MANAGEMENT AND ITS PLATFORM PROCESS

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Lake Nakuru (36° 05' E, 00° 24' S) is an alkaline, saline lake located in the eastern arm of the Great Rift Valley in Kenya. The lake has been variously described as “the lake of a million flamingos” and is a bedrock to the areas’ tourism. The lake and surrounding park was designated as Kenya’s first Ramsar site in 1992 and a UNESCO World Heritage Site in 2011.

Since 2012 the lake level has been rising from an average level of 2.5 meters to the highest level of 10.5 meters recorded in July 2021. This has resulted in a significant increase in lake area from 31.8 km<sup>2</sup> in 2012 to 70 km<sup>2</sup> in 2022, consequently, inundating about 26.6 km<sup>2</sup> of the park area.

To determine the impact of the rising water levels, satellite imagery, Alos Palsar Digital Elevation Models with 12.5m resolution and a digitized Lake Nakuru boundary as of June, 2021 were analysed using remote sensing and GIS software. Hydrological and geo-hydrological data was used in setting up a lake water balance model. The Soil & Water Assessment Tool (SWAT) was adopted for this work.

Land-use/ land cover changes were assessed using Landsat-7 satellite images with 30m spatial resolution covering the catchment area for the years 1990, 2000, 2010 and 2019.

The rising water levels is attributed to a strong response to the enhanced rainfall during the 2010-2020 period. The main driver to the rising water levels is climate change with mounting evidence from the level of rainfall in the catchment areas as documented at the various rainfall gauging stations. There has been increase water supply due to increased runoff brought about by another variable of land use characteristics. The fragility of the lakes ecosystem has created instability in the ecology of the lake through the increased input of freshwater, impacting on species resilience and distributions, especially a change in the fish species diversity and a decline in Lesser flamingo (*Phoeniconaias minor*).

The lake flood waters have inundated the lower sections of the Old Town Sewage Treatment Plant. Integrated Lake Basin Management (ILBM) should be mainstreamed as a strategy to provide an integrated framework for the sustainable management and use of Lake Basin resources through informing policies, strategies, plans, projects and programmes, as well as to guide coordinated agency actions.

## TITLE

## PERIODICITY AS A REASON OF ENTANGLEMENT OF INTERCONNECTIONS BETWEEN PHYTOPLANKTON AND CLIMATE CHANGE IN A SHALLOW LAKE

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Eutrophication (and the “water bloom” as its main sign) is a very well-known global phenomenon of the second half of the XX century and the first quarter of the XXI century. In last two decades global climate change such as warming has joined to routine aggravation of eutrophication through nutrients input. This is in focus of many recent works. Despite such popularity of the problem great majority of questions remain unsolved. First of all, how phytoplankton can “answer” to temperature and rainfall, which both are direct markers of climate change. The aim of our study is to clarify interrelations between phytoplankton and inter-year weather conditions (by air temperature and rainfall) in the littoral of small and shallow temperate lake. We tested the hypothesis that concentration of chlorophyll “a” and air temperature are directly and positively correlated as more frequently observed in many water bodies. We understand, that this statement is rough approximation of natural situation, but it may serve as a start point of our exploration.

The model water body for our study is mesotrophic Lake Hupujarvi which is situated on the Karelian Isthmus, one of the lacustrine regions of North-Western European Russia. The lake is characterised by a small drainage ratio (7.71), which explains its autochthonous regime and slow water exchange (the average water exchange time is 5.31 year). The water-surface area is 0.28 km<sup>2</sup> (the littoral zone is 0.21 of the area). The depths: average is 2.14 m; maximum is 3.8 m. The lake is open and is not affected by any source of pollution. The water body is observing from 2011 up to now during vegetation season (May – September). In this work we consider data on 2011-2022.

In our observations we revealed the 4-year periodicity in chlorophyll “a” dynamics with high chlorophyll (eutrophic condition) in comparatively warmest years (2018, 2021, 2022). In other words, from 2015 to 2018 and from 2019 to 2022 chlorophyll is increasing, while in 2015 and 2019 we observed minimal average concentration of the pigment. However, all data on the chlorophyll didn’t exhibit any relations with temperature for observation period. Analysis of covariance allow us to prove that rainfall determine 4-year periodicity. Analysis of time series showed the visible coherency between rainfall and chlorophyll content in the lake water with the period of 4 year. First 4-year period (2015-2018) was rainier than the second (2019-2022). Conditionally we call these 4-year phases as “rainy” and “droughty”. In “rainy” phase the connection between chlorophyll and temperature has not been proved, while in “droughty” this relation is medium in degree and highly reliable ( $r=0.43$ ,  $p=0.009$ ).

In conclusion, the process of eutrophication (estimated by the dynamics of the concentration of chlorophyll “a”) does not seem monotonous, but has periodicity associated with the water regime of a lake. It is notably, that the value of period, 4, is very close to value of the water exchange time. Water exchange time should be accounted for when we explore long-time dynamics of freshwater phytoplankton.

## TITLE

## INTEGRATED LAKE BASIN MANAGEMENT (ILBM) - A CASE STUDY OF LAKE POWAI, MUMBAI, INDIA

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Powai lake is an important ecological land mark on the map of megacity with more than 2 billion population of Mumbai, the financial capital of India and has total water spread area of 210 hectares. It is a man-made impoundment built in 1881. Conservation of Powai Lake is in the interest of man for its ecological, cultural and tourist values and one of the most important steps in the conservation of the lake is restoration of its water quality complimented by other conservation and management measures. The local communities depended on the lake for fishing for their livelihood and income. The lake is under severe stress mainly due to anthropogenic activities including improper beautification, release of sewage, solid waste dumping, weed infestation, pollution, and siltation thereby decrease in fisheries production and loss of biodiversity. The resultant impacts on the livelihoods of the lake dwellers showed change in their occupational structure and income, increase in unemployment and health problems.

Based on these findings, a long term water quality monitoring program along with an action plan and strategy for its effective implementation through stake holder participation is recommended based on the Guidelines and approach developed by Integrated Lake Basin Management (ILBM). An ILBM document is under preparation. Powai lake conservation Society (Sarovar Samvardhini) is already established to initiate actions.

## TITLE

## IT TAKES A TRIBE TO RESCUE A RIVER: A NEW APPROACH TO RIVER REHABILITATION IN THE PHILIPPINES

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The municipality of Taytay in the Province of Rizal in the Philippines has rapidly developed in the past 15 years with the revival of the garment manufacturing industry that attracted businessmen in the area. It has an urban environment with a population density of 9,960 people/km<sup>2</sup>. Taytay's river systems drain into Laguna de Bay but all of them are chronically dead. Attempts to revive the main river and its tributaries by regular clean-up drives alone were found ineffective, hence, the Municipal Council sought the help of environmental scientists, who then formed the proposal for a river rehabilitation project. The result is a project funded by the Department of Science and Technology with the title: A Model Rehabilitation of a Laguna de Bay tributary - Taytay River - Maningning Creek (LdB-TR-MC) sub-basin. It is dubbed as the Taytay River Initiative for a Better Environment (TRIBE) for better communication with the stakeholders. The project aims to establish and develop a community-based river basin rehabilitation program that is practical, science-based and replicable. The main project site is Maningning Creek, a small tributary of Taytay River, whose upstream and downstream segment are confined in the municipality. This makes it more manageable in terms of water quality monitoring and in formulating rehabilitation ordinances. Through a multi-stakeholder workshop that gives importance to the contribution of elders in the community, a common vision was formulated and that is, "Maningning Creek and its environs is a livable river system not only by humans, but also by freshwater fish, benthic invertebrates and plants." To achieve this, collaborations that transcend the laboratory are implemented by reaching out to the communities and local government officials from the municipal to the barangay level, the latter being the basic political unit in the Philippines. The targeted technical interventions were determined by first identifying the baseline water quality, the various activities and conditions that affect the water quality, and the appropriate water quality indicators. The Barangay Council of Sta. Ana allotted budget for technical intervention such as the prototype domestic wastewater treatment facility. The development of a water quality monitoring program, as well as evaluation of the effectiveness of the interventions were done at the community-level through citizen-science approach. It highlights the significance of interventions that start at a smaller scale where experiences are earned and lessons are learned, which can be replicated and upscaled in other Laguna de Bay sub-basins. It is envisioned that the TRIBE project model can improve the water quality of Maningning Creek which could be sustained beyond the life of the project. This necessitates the formulation of sustainability measures and the binding commitment of stakeholders from the local government officials, the community, the academe and other expert groups and policy makers.

## TITLE

**LOCAL GOVERNMENTS: KEY ACTORS IN IMPLEMENTING SUSTAINABLE MANAGEMENT OF PHILIPPINE LAKES**

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Lake basin management structure and governance mechanisms are diverse and are determined by the political, economic, social, cultural and environmental conditions. In the Philippine setting, the watershed is composed of political units ranging from the provincial, city, municipal and barangay (village), the latter being the smallest political unit in the country. The enactment in 1991 of Republic Act 7160, known as the Local Government Code (LGC) paved the way for the decentralization of the authority, powers and functions of national government agencies to LGUs. With regards to Environment and Natural Resources (ENR) management, every LGU is mandated to share responsibility in environmental management and sustainable development of natural resources within their jurisdiction. The office of the Environment and Natural Resources Officer (ENRO), although optional in the law, was created in almost all provinces, cities and municipalities. The formulation of an Environment Code has gained ground in progressive localities and is now being replicated in other LGUs of the Philippines.

The involvement of LGUs in ENR management is best demonstrated in the Laguna Lake Basin. At the policy level is through the representatives of the provincial, city and municipal officials in the Board of Directors of the Laguna Lake Development Authority (LLDA), a semi-government corporation created through Republic Act 4850 (1966) to lead and promote the development of the Laguna de Bay Region with due regard to the environment. On the operational level is the exercise of their function as local executives in their respective localities. The creation of Watershed Management Council (WMC) by the LLDA in each of the sub-basin of Laguna Lake opened the door for local officials at the barangay to be directly involved in the plans, programs and activities to improve the water quality of tributary rivers which in the longer term will help improve the water quality of Laguna Lake. This is embodied in the Clean Water Act of 2004 which identifies river basins and lake basins as Water Quality Management Areas (WQMA) under the supervision of a WQMA Board. The Laguna de Bay Region Water Quality Management Area Governing Board was organized in compliance with the law. Part of the revenue generated by LLDA in the implementation of the Environmental User Fee System is allocated for water quality improvement programs and projects which the WMC can avail in accordance with the requirements set forth by the LLDA.

With these significant roles of the LGUs, it is imperative that they understand the behavior and unique characteristics of lakes and rivers to determine appropriate management and intervention measures. In addition to politics and local governance, a course on lake basin management tailor-fit for politicians and local leaders must be developed to give them the basic knowledge needed in managing lake basins. The Integrated Lake Basin Management (ILBM) approach developed by the International Lake Environment Committee Foundation (ILEC) and a team of international experts is a good starting point.

## TITLE

**DIVERSITY OF LITTORAL ZONE BENTHIC MACRO-INVERTEBRATES AS BIOINDICATOR OF WATER QUALITY IN REWA BANDH, KAWARDHA, CHHATTISGARH, INDIA**

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Macroinvertebrates play a key role in the littoral zone of lakes. Benthic macroinvertebrates are important food sources for higher trophic levels in lake food webs. Hence, diversity of littoral zone benthic macroinvertebrates of Rewa Bandh was studied during July, 2021 to December, 2021. Altogether two site of the littoral zone of the Rewa Bandh were sampled for benthic Macroinvertebrates by using of an Ekman dredge soil sampler and Secured in bucket and water was added to it. Using "US standard Sieve No. 40. The whole sample was sieved to obtain the benthos with help of forceps for preserving the same in bottle. The water quality data for Rewa Bandh indicated that pH was in alkaline range and Electrical Conductance values were above 0.20 mS in this water body. On the basis of visibility values of Rewa Bandh were categorized as "hypereutrophic Based on alkalinity values have been found highly productive. On the other hand nitrate-nitrogen values of Rewa Bandh were "Mesotrophic" whereas on the hardness were "Moderately hard". The diversity of Macroinvertebrates was fairly good in the Rewa Bandh as evident from 27 Species. The average density obtained for the five benthos was in the following order of dominance: Chironomus Larvae (448) > Melanoides tuberculata (114) > Bellamyia bengalensis (110) Gyraulius convexiusculus (80) > Psychoda larvae (74) No./m<sup>2</sup>. The total number of macroinvertebrate species ranged from 1166 to 1357 No/m<sup>2</sup>. The Odum and Menhinick's indices showed lowest diversity in Rewa Bandh. Chironomus Larvae, Lymnaea acuminata and Melanoides tuberculata may be used as pollution indicators in Rewa Bandh. From the present investigation, it is inferred that littoral zone benthic macro-invertebrate community can be useful in evaluating the localized effects of organic enrichment in the lentic water ecosystem.

## TITLE

## THE EUROPEAN LIVING LAKES ASSOCIATION (ELLA): FOSTERING THE SUSTAINABLE MANAGEMENT OF LAKES AND WETLANDS IN EUROPE

## AUTHOR(S)

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Lakes and wetlands are among the most threatened ecosystems in the world. In Europe, the majority of surface waters are not in good ecological status and have significantly deteriorated over the last decades. Climate change, pollution, eutrophication, water abstraction, and land use changes are some of the main contributors to the degradation of aquatic ecosystems. In face of these issues, the European Living Lakes Association (ELLA) has been recently formalized to promote a more sustainable management and use of terrestrial water bodies as well as their resources and biodiversity. ELLA aims at a fruitful collaboration between all relevant stakeholders in lake regions, i.e. regional and local authorities, companies, civil society organizations and scientific institutions to foster the protection and restoration of lakes and their connected ecosystems in different corners of Europe. Strategies to achieve this include: the support of appropriate legal frameworks, the implementation of climate change mitigation and adaptation measures, the initiation of new projects on sustainable development of lake regions, the involvement of the business sector (particularly from agriculture and tourism) in restoration strategies and projects, the execution of awareness-raising and environmental education activities, and the contribution to applied science, participatory monitoring and participatory lake stewardship.

## TITLE

## HEAT USAGE OF LAKES: POTENTIAL AND IMPACTS

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Lakes are increasingly being used as a source of energy for heating and cooling buildings and infrastructure. In Switzerland, several commercial-scale plants have been commissioned in recent years or are in the planning stage. The advantages of this energy source are obvious: it is renewable and local and thus ideal for replacing fossil fuels, which are still the main source of energy for building heating systems in Switzerland today. Disadvantages are the high investment costs, the additional electricity needed to run the heat pumps, and the possible negative impacts on lake ecosystems.

This presentation discusses the potential of lakes for heat production and dissipation and the resulting impacts on lake temperature and stratification and thus on lake ecosystems. A number of case studies of lakes of different sizes and altitudes, characterised by different types of mixing regimes, are presented. Numerical simulations show that for most existing or planned systems the impacts on the thermal structure of the lakes are negligible, both compared to the interannual variations and compared to the already observed and - even more - to the further expected impacts of climate change. Nevertheless, for smaller lakes or large systems, and particularly for significant heat discharges that may exacerbate climate impacts, a careful assessment of the lake-specific effects is required.

## TITLE

## CURRENT STATE AND FUTURE PERSPECTIVE OF LAKE SEVAN, ARMENIA - RESULTS OF A GERMAN-ARMENIAN RESEARCH PROJECT

## AUTHOR(S)

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Lake Sevan (Armenia) is one of the largest high mountain freshwater lakes of Eurasia (1250 km<sup>2</sup>, 39 km<sup>3</sup>). For Armenia, it is a key element of the country's environment, a strategic freshwater reserve, a source of fish, a touristic destination and, last but not least, of high cultural value for the Armenian nation. In the 20th century, Lake Sevan experienced water level draw down by up to 19 m (ca. 40% loss of volume) in order to use the water for hydropower and irrigation. However, the decrease of the water level was eventually stopped in 2002 and the water level has been increased again by ca 4 m while an Armenian law requires a further increase by 3 m until 2030. The drop of the water level and the parallel increase of population in the catchment, of land use intensity and overfishing also affected the water quality of Lake Sevan in terms of eutrophication and the loss of endemic fish species. Introduction of new fish species also contributed to that development. After some improvement of the water quality in the 1990s and 2000s, cyanobacterial blooms again occurred since 2018 as previously in the 1960s and 1970s.

After a period of almost missing (since 1990) or quite limited (since 2005) monitoring, a monthly sampling of Lake Sevan was implemented within the German-Armenian research projects SevaMod and SEVAMOD2 in 2018. These projects also included basic investigations of the phosphorus content of Lake Sevan's sediment and the development of numerical models for simulating the consequences of climate change and potential changes in the management of Lake Sevan and its catchment.

In the presentation, the main results of the projects will be presented after a basic introduction to Lake Sevan and its development in the past. The analysis of the major ions in the lake and in the inflowing rivers indicated the consequences of the enormous evaporative losses, except for calcium which is most likely removed from the water by phytoplankton-induced calcite precipitation. The retention of phosphorus in Lake Sevan was found to be in the range of 90% while the annual load from the rivers showed a slightly increasing trend since 2012. 20 to 60% of the sediment phosphorus content was found to be potentially mobile in the top 2 cm and represent a considerable risk of internal loading and increased eutrophication. The developed models were able to reproduce the water temperature and, thus, the seasonal stratification very well. Climate change will result in increasing water temperatures at the lake surface as well as in the hypolimnion and the duration of thermal summer stratification will increase while ice cover in winter will almost fully be missing in the second half of the century. Model simulations also indicated that further increase of the water level would reduce the risk of anoxia at the lake bottom. However, decreasing the nutrient inputs by better management of the catchment is the more promising approach for improving the water quality of Lake Sevan.

## TITLE

## IMPLEMENTING PARTICIPATORY ECOSYSTEM SERVICES SHARED VALUE ASSESSMENT IN MALAYSIA

## AUTHOR(S)

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Reservoirs, lakes, and ponds provide crucial ecosystem services for both human and natural life. Despite their importance, managing these lakes - both natural and man-made - remains a challenge due to the intrinsic nature of the lentic water bodies, anthropogenic pressures and climate conditions. There are still no comprehensive integrations of the shared value of lake ecosystem services to support sustainable governance of lake basin. Stakeholders' perspectives on ecosystem services (ES) varied, which made it difficult to successfully manage the lake basin and the services connected to it. Ecosystem services shared value assessment is a new methodology used to incorporate the ES concept into the lake basin management planning. The method has been successfully used in few African lakes to encourage people to take an active part in lake management. The concept of involving communities to develop shared values to improve the participatory process of basin management is still new in Malaysia. This paper provides an overview of Malaysia's implementation of the participatory ecosystem services shared value assessment (PESSVA). The collaborative project between the National Water Research Institute of Malaysia and International Lake Environment Committee on PESSVA starts with the Chenderoh Lake Basin followed by the Bukit Merah Lake Basin, both located in Perak, Malaysia. The work involves developing questionnaires, conducting social surveys, and confirming with stakeholders in workshops. The survey for Chenderoh Lake was carried out from January to March 2023 covering two districts namely Lenggong (upstream) and Kuala Kangsar (downstream). More than 300 respondents from ten sub-districts participated in the survey.

The initial findings of the survey of the local communities and stakeholders in Chenderoh Lake basin revealed that more improvement was required to strengthen lake basin governance. Lack of knowledge and programs was perceived by community to may limit their involvement in lake basin management. PESSVA survey is currently being undertaken in Bukit Merah Lake Basin. Comparative analysis of survey data from the two lakes will provide better understanding on the role of PESSVA in supporting the planning process, management actions and overall governance of lake basin in the two water bodies.

## TITLE

**SYNERGISING LAKE MANAGEMENT WITHIN WST2040 OF MALAYSIA**

## AUTHOR(S)

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Malaysia has taken various initiatives since 2007 to sustainably manage lake governance. Current achievements of lake management in the country are adoption of the Strategic Plan for Sustainable development and management of lakes and reservoir in 2012 and National Lake Water Quality Criteria and Standards in 2017. A guideline and research on Integrated Lake basin management plan were carried out for seven lakes (2016 to 2020). An updated inventory of lakes which include ex mining ponds, with significant environmental services, was undertaken in 2021. An additional of 11 lakes have had their lake briefs documented, compared to 28 lakes from 2009 to 2012.

In connection to enhancing the country's water management, WST 2040 (Water Sector Transformation by 2040) study for Malaysia was endorsed to be implemented in December 2021, encompassing the whole water sector which therefore encompasses lake resources and subsequently their governance. The proposal and recommendations of the WST2040 study, have been uploaded into the internet public domain - <https://wst2040.my/>. The WST2040 implementations are expected to be carried out from 2021 to 2040. The recommendations encompass suggestions from known existing studies and recommendations from eight (8) new detail studies within the WST2040 Study, i.e., Advocacy, Awareness Creation and Capacity Building, Integrated Water Sector Data Centre (IWSDC), IR4.0 in the Water Sector (IR4.0WS), Water Food Energy Nexus (WFEN), Virtual Water and Water Foot Print (VW&WF), Climate Change Impact and Adaptation (CCIA), Alternative Water Financing (AWF) and Water as an Economic Sector (WES). Overall, the aim of water sector transformation 2040 is to ensure the availability of clean and sustainable water resources for future generations, while addressing the challenges posed by population growth, urbanization, climate change, and other factors.

This paper focuses on enhancing lake management, riding on the policies recommended under WST2040, including creating awareness and capacity building, recommending required new researches, development of new indigenous technologies, innovation, and commercialization of such technologies to help further improve lake management by all, including local communities.

## TITLE

**"...LORD, MY GOD, I MEASURE, I MEASURE, BUT WHAT I MEASURE, I DON'T KNOW...!" - NEW POSSIBILITIES FOR MEASURING SCIENTIFIC PUBLICATIONS; ALTERNATIVE METRICS**

## AUTHOR(S)

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The evolution of science in the 21st century and the profound changes in scientific communication place corresponding demands on science metrics. This process is driven by two development trends which, although interlinked to a greater or lesser extent, are essentially separate in their nature. The first is the modernisation and adaptation of traditional services, and the second is the emergence of new types of procedures specialising in new types of content, applications, and opportunities on the Internet, which are known as alternative metrics at the level of everyday life.

In this presentation we will take stock of the latter, the procedures, methods, and results of alternative metrics. The concept of alternative metrics has two meanings: on the one hand, a specific set of methods and tools that function through the mediation of the Internet and its social application, and on the other hand, a specific product: altmetrics.

The emergence of alternative metrics was based on the expansion of online scientific publications on the web and the emergence of Open Access and Creative Commons, the CC License. These conditions have now been combined into a complex system, ensuring both the widespread exploitation and accessibility of the results of scientific output in the form of publications and the enforcement of copyright.

The Altmetrics toolkit measures the impact of scientific communication on the scientific community, with the important feature that it is validated alongside, rather than in place of, traditional metrics. Altmetrics is also new as a science metric in that it works with data harvested from the web, i.e., it is an open, transparent system, whereas some of the traditional tools for measuring scientific quality, such as peer review or the Journal Impact Factor, are closed systems that cannot be viewed from the outside. The advantage of an open and automated system is not only transparency, but also that it is cheap and there is no monopoly provider who can charge an unreasonably high price for the service.

In this presentation we will only cover the most popular and widely used alternative metrics, such as Altmetrics, PlumX Metrics, Webometrics, author profile options.

## TITLE

**AN ASSESSMENT OF THE ENVIRONMENTAL IMPACT OF THE KAKHOVKA RESERVOIR DAM BREACH, UKRAINE**

## AUTHOR(S)

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The dam of the Kakhovka Reservoir and hydropower plant, known as the Kakhovka Dam or Nova Kakhovka Dam, near Nova Kakhovka town, Kherson Region, Ukraine, suffered a catastrophic breach on 6 June 2023.

We report here on a UK Foreign and Commonwealth Development Office commissioned rapid environmental risk assessment designed to (i) assess the flood conditions and recovery using hydraulic modelling, (ii) conduct a GIS-based assessment to quantify impacts on habitats, species and other impact indicators, and (iii) to map hazards informing a plausible spatial risk assessment using the UN Disaster Risk Reduction Hazard Framework.

The maximum flood extent was estimated at 83,000 hectares (~2.6 times the land area of Malta) with maximum flow speeds on the flood plain of around 1 m/s, and a maximum water depth in the affected urban areas of around 2 m. Over half a million hectares of habitat of national or international conservation importance will have been affected by the dam breach along a continuum from the Kakhovka Reservoir to the Black Sea, exposing 567 European Red List species to a range of hazards, 58 of which are globally threatened ('vulnerable' status or worse). For comparison, Ukraine has 147 globally threatened species whereas the United Kingdom has 200 (IUCN, 2023).

For terrestrial species, direct loss or damage of nests and offspring will have occurred, affecting for example birds nesting on the ground, (e.g. little gull, little bustard) or in emergent vegetation. These species breed in the affected area and are European Red-listed species, classified as "near threatened" or "vulnerable". Terrestrial habitats in the flooded areas downstream are composed mostly of herbaceous wetlands (around 35,000 ha, 51% of the affected downstream area, ESA WorldCover 2021) in the Dnipro valley and delta. These wetlands are a mosaic of rivers, streams, ponds, floodplain forests, reedbeds and sandbars.

Potential pollution sources which have been flooded include wastewater treatment works, petrol stations, landfills and other industrial infrastructure. Historical pollutants contained within reservoir bed sediments – potentially including mine waste, munitions, and radioactive substances will have been dispersed across the aforementioned habitats and into the coastal ecosystems of the Black Sea Biosphere Reserve.

References: IUCN, 2023. IUCN Red List of Threatened Species - Table 5: Threatened species in each major group by country. <https://www.iucnredlist.org/statistics>, accessed 28th June 2023

ESA WorldCover, 2021: <https://worldcover2021.esa.int/>

Report Citation: UKCEH & HRW, 2023. A rapid assessment of the immediate environmental impacts of the destruction of the Nova Kakhovka Dam, Ukraine. Report prepared by UK Centre for Ecology & Hydrology and HR Wallingford for the UK Foreign, Commonwealth & Development Office (FCDO) Expert Advisory Call Down Service 2 Lot 4 Rapid Assessment of the Environmental Impacts of the destruction of the Nova Kakhovka Dam, Ukraine. 29 June 2023.

## TITLE

**LAKE(SIDE) IS EVERYWHERE - INTEGRATION OF NATURAL ENVIRONMENT INTO TOURISM EXPERIENCE**

## AUTHOR(S)

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Tourism experience depends greatly on the surrounding environment, commonly understood as the physical environment. In case of destinations with waterfront areas, the natural environment is a fundamental part of the experience that can ensure uniqueness of it. The natural environment including water surface itself can be a motivation for visitation, and can be identified as a 'scene' for tourism experiences. The study is based on a quantitative survey conducted among the Hungarian population (sample size of 1,000 persons). Respondents were asked to report details about an overnight leisure trip to Lake Balaton, and so about activities done during the trip. The activities can be grouped according to their link with lake(side), so water-dependent, water-related, and water-independent items were categorized. According to the research results, for leisure tourists to Lake Balaton, the lake itself and its surroundings have a cutting edge role in the tourism experience. In order to benefit the most from the valuable natural environment, outdoor activities are dominant. The study contributes to the theoretical knowledge by understanding visitor segments based on activities done. Among the practical implications, the study highlights the potential for developing unique, destination based tourism experiences, and unveil the potential for cooperation between stakeholders.

## TITLE

## THE LEGAL ASPECTS OF ECO-DRR IN ENVIRONMENTAL TREATIES AND ITS NATIONAL IMPLEMENTATION: TOWARD A SUSTAINABLE LAKE MANAGEMENT

## AUTHOR(S)

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This study focuses on the legal system for social implementation of watershed flood control that combines the perspectives of sustainable community development and environmental conservation, particularly from the aspects of international environmental law and Japanese environmental law.

The water-related disasters that have occurred around the world in recent years are faced not only by Japan but also by many other nations, and there is an urgent need to prepare for such disasters and to respond to the expansion of damage. The international community has responded to disaster prevention and mitigation in three major phases: pre-disaster, during disaster, and post-disaster. In recent years, the perspective of utilizing natural ecosystems in a way that has a synergistic effect with the response to climate change has been incorporated into environmental treaties and adopted as resolutions and decisions by the Contracting of the Parties

The need for integrated management that takes advantage of the characteristics of lakes has been specifically addressed in the UNFCCC, which requires Parties to prepare appropriate and comprehensive plans for the management of coastal areas and for the protection and restoration of areas affected by flooding. The Ramsar Convention also requires parties to consider the basic ecological functions of wetlands as water regulators. In addition, UNEP has announced that a resolution on sustainable lake management was adopted by the United Nations Environment Assembly on 2 March 2022. It is therefore essential that domestic implementation be carried out in accordance with the requirements of the international society.

Flood control has long been an important policy issue in Japan, and flood control measures have been implemented mainly through river improvement and sewerage improvement.

In 2021, nine laws were revised in Japan under the Act on Countermeasures against Flood Damage of Specified Rivers Running Across Cities to try to ensure more effective policies. In addition to trends in the international community, we will examine the response to Eco-DRR and its challenges in Japan, using Lake Biwa and other lakes as examples.

## TITLE

## ROLE OF LAKES IN THE WATERSHED CONTEXT FOR ENVIRONMENT SUSTAINABILITY AND WET LAND ECOSYSTEM GOVERNANCE OF ONGUR SUB BASIN OF TAMILNADU PROVINCE IN INDIA

*(THE ROLE OF GROUND WATER RESOURCES AND THEIR MANAGEMENT)*

## AUTHOR(S)

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The Grassroot project comprises of four micro watersheds namely Arasur, Nugumbal, Othivilagam and Sirukalathur (12.305534° 79.900310°) covering 5400 Ha. 3650 Ha of the watershed area was treated through various soil and water conservation measures. Rejuvenation of 20 major lakes and 25 minor waterbodies was done for better augmentation of ground water. All these major and minor waterbodies were well networked through drainage line system forming a cascade of waterbodies to enhance the rainwater harvesting potential. The water storage potential was increased from 100000 Kilo litres to one million Kilo litres. The Ground Water level has increased by 12-15 ft over a period of Five years. The additional area brought under cultivation is around 780 Ha and the average cropping intensity has increased from 90% to 135%. The vegetative and green cover development within the region has witnessed a significant change leading to the crop diversification along with climate change adaptation practices followed by the farmers. It has benefitted nearly 3000 families (both land holders and landless) comprising of 10500 members.

The project was also helpful in balancing the water demand among scarce and abundant years. The historical climate data shows the pattern of having three consecutive years of flood, drought and normal condition in a decade. The project area is in lesser proximity to the sea which might lead to the discharge of huge quantum of fresh water into the sea without these structures. The role of lake rejuvenation project with a watershed context has ensured environmental sustainability. It had multiple benefits like preserving the wet land ecosystem with better governance by farming community, augmenting the ground water recharge to mitigate climate risks and balancing the extremes of vagaries of weather resulting in bringing the project location from Over exploited zone to Safe zone in five years. This success had helped in replicating similar projects in 20 other micro watersheds in seven different provinces of India. This model has the potential to bring solutions for a global challenge at a regional context.



## TITLE

## COMPREHENSIVE ANALYSIS OF THE GEOLOGICAL, HYDROGRAPHIC, LIMNOLOGICAL, CLIMATIC, AND VITICULTURAL PARAMETERS OF THE TOKAJ WINE REGION

## AUTHOR(S)

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The Tokaj Mountains are one of our most famous volcanic mountain ranges, with geological properties significantly different from other regions. The mountain range is located at the confluence of two rivers, providing unique climate and hydrographic conditions and nutrient-rich soils for the World Heritage viticultural landscapes of Tokaj. However, climate change, intensive agriculture, increasing tourism and insufficient water resource management may have an adverse impact on the precious water resources of the region, with particular emphasis on the environmental status of lakes and limnic ecosystems. We have ample amount of data regarding the water resources in the area, called the Határ-ér ('Border-vein') water system in the southern part of the Bodrog River, which is an open floodplain with numerous small, shallow lakes and veins, many of them represent unique aquatic habitats and a range of different limnic ecosystems. The ecologically most valuable part of the water system is the lower-lying Tímári Meadow, receive only limited amount of water from rivers Tisza and Bodrog, in one third of the years. Therefore, water replenishment from the Tisza and Bodrog rivers might be required taking into consideration extended periods of draught and raising summer temperatures in the future due to climate change. Our previous research mapped the geological and hydrogeological parameters of this area and tracked hydrological variations over the years yielding extensive data on temperature fluctuations, precipitation levels and distribution, and daily humidity variations in this region attributed to climate change. Furthermore, precise data are available on grape production and wine quantities, including detailed information on the quantity and quality of different vine varieties. The environmental impact of monocultural farming practices on surface and subsurface water resources and soil properties will be examined. We will investigate how extreme weather conditions, precipitation levels, and distribution affect surface and subsurface water resources, near-surface humidity, and how these factors impact grape cultivation, different vintages, and the physiological components of wines. The goal of this project is to create a holistic, ecologically resilient, economically viable and sustainable management concept of these valuable aquatic ecosystems, taking into consideration their carrying capacity in view of climate change and the effects of anthropogenic activities with particular emphasis on agriculture.

## TITLE

## MANAGEMENT OF SHALLOW LAKES IN RECHARGE REGIONS OF GROUNDWATER FLOW SYSTEMS IN CASE OF WATER SHORTAGE

## AUTHOR(S)

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Climate change and the increasing human impacts affect not only our groundwater resources, but also the connected wetlands and lakes. Recharge areas of the groundwater flow systems are the most vulnerable regions, where the downward moving groundwater results in a negative water balance. Consequently, intense water level decline occurs and shallow lakes dry up.

In Hungary, Nyírség region is located in a regional recharge position and it is one of the most impacted areas, where several km<sup>3</sup> water is lacking from the subsurface due to climatic change and human activity in the last fifty years. By the declining water table shallow lakes started to disappear or their area reduced. In order to preserve these shallow lakes and wetlands, a system-approach is required. Delineating the natural conditions, understanding the groundwater flow dynamics and the groundwater-lake interaction are the foundation of finding a proper solution to the problem.

In our study two shallow lakes were investigated in the South-Nyírség region, which represent pilot areas for studying management of lakes and wetlands in regional recharge position of the Great Hungarian Plain.

Hydraulic data process, chemical data evaluation, and numerical simulation revealed that the lakes are supplied by local groundwater flow systems, superimposing the regional-scale recharge conditions in the area. The lakes are located in local discharge and flow-through situation. In addition, the position of the regional water table is decisive, because in case of significant water level decline local flows are degraded, so they are not able to sustain the wetlands. To preserve the shallow lakes water retention solutions at the local recharge areas of the lakes may help in mitigation of the water level decline under present day conditions. If the regional water table continues to decline, comprehensive water retention solutions are needed in the whole region.

The results highlighted the significance of understanding natural groundwater-lake interaction at different scales to find appropriate lake management solutions or water retention strategies. This research was funded by Hortobágy National Park Directorate, „Nyírségi és bihari vizes élőhelyek rehabilitációs programja (projekt-előkészítés)” KEHOP-4.1.0-15-2021-00098 project and by the National Multidisciplinary Laboratory for Climate Change, RRF-2.3.1- 21-2022-00014 project.

## TITLE

## “REVITALIZING MORIYAMA AND LAKE BIWA: DISCOVERING CONNECTIONS THROUGH ECO-TOURISM FOR COMMUNITY EMPOWERMENT, ENVIRONMENTAL LEARNING, AND SUSTAINABLE DEVELOPMENT”

## AUTHOR(S)

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In the Moriyama district of Otsu City (Shiga Prefecture), found on the west side of Lake Biwa, we have implemented an eco-tourism program to “follow” and “enjoy” the connections found between the mountains, villages, and lakes. By “following” water, “following” culture, and “following” paths alongside the local people, on this tour, we seek to discover the many diverse characteristics of the region. The Moriyama region is currently unequipped to sufficiently maintain its mountains due to the declining birthrate and aging population. Proper mountain maintenance is of utmost importance as it heavily impacts disaster prevention methods and the livelihood of those who reside nearby.

The tour is two days and one night, and by actually “following” the water path from the mountains to Lake Biwa, visitors can directly feel the connection from the headwaters to the mouth of the river. Throughout the two days, visitors will learn and experience the history, environment, culture, and culinary experiences of the mountains, villages, and lakes.

This tour employs a new system of “local curators” which are people who have extensive knowledge of the area and/or hold relevant professions. They are responsible for facilitating connections between participants of the tours and the local residents. As participants connect and become friends with those in the local community, they will likely return to visit and thus increase the number of people involved in the Moriyama area.

We are considering donating 10% of the total tour cost to the Moriyama community association. Local curators will also be compensated for their work and play an economic role in improving the region.

By implementing this tour, we aim to circulate the local economy, to strengthen the connection between the lake’s ecosystem and the local people, and to advance the environmental conservation efforts by creating a system that gives back to the community each time the tour is held.

## TITLE

## LIVING LABS FOR CONSERVATION AND SUSTAINABLE USE OF LAKE ECOSYSTEMS

## AUTHOR(S)

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Living Lab is an applied research and knowledge-transfer concept in which experimentation and co-creation take place in a real environment, where a wide range of stakeholders are involved to transfer knowledge and know-how and implement new and innovative products and services. With Living Lab-based interactive value creation by developing sustainable business models based on circular economy, nature-based solutions, community participation, capacity building and regenerative environmental management the adverse impacts of human activities on the threatened ecosystems of lakes and their hydrographic catchment areas can be reduced or eliminated while the economic and social viability of these regions will be secured. Regarding lakes and wetlands, there are some famous good practices such as the Lake Superior Living Labs Network, embracing the ecosystems of the world’s largest freshwater in North America to identify innovative solutions at the intersection of water, food, land, climate, energy, individual and community well-being, or the multinational ALFA wetlands HORIZON project focusing on peatlands, wetlands, and floodplains across Europe to improve the geospatial knowledge base of wetlands from 10 European countries. Living Labs for lakes often have a vital function of revitalisation and regeneration of habitats, which have been damaged or eradicated through ecosystem fragmentation and/or pollution or excessive use of water resources such as irrigation, water transport, and regulation of rivers, which are essential as water supply for lakes. Living Labs related to freshwater habitats may be created in many different forms and with several functions such as biodiversity conservation of limnic ecosystems, organic agriculture in coastal areas, soil health, aquaponics, bird sanctuaries and bird watching, fishing, and angling, or ecotourism. It is important to point out the social and eco-political significance of living labs, since one of their key functions is knowledge transfer through community participation with an inherent element of formal and informal education being herewith an indispensable part of lifelong learning for regenerative sustainable development. Our intention is to suggest the establishment of an assessment programme to identify the development needs of freshwater ecosystems and adjacent areas exposed to environmental pressure due to human activities where Living Labs may offer long-term solutions for environmental and socio-economic problems.

## TITLE

## TEACHING CONSERVATION OF WATER RESOURCES FOR PRIMARY SCHOOL PUPILS THROUGH GAMIFICATION AND PRACTICE-BASED INTERACTIVE METHODS

## AUTHOR(S)

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Nature conservation must be taught in all educational institutions and is part of the National Curriculum. The teaching of this knowledge should be promoted from an early age, with the involvement of state and municipal institutions and other organisations, in order to foster a culture of nature conservation in society. However, the protection of water as an environmental element, wetlands (including, of course, protected springs, wetlands, and salt lakes) native, indigenous fish species, aquatic habitats as well as the protection of natural standing waters and rivers, directly serves the protection of nature and is therefore also a task of nature conservation. It is a difficult and complex didactic task to familiarise primary school pupils with the biotic community of waters and water banks, water pollution and its consequences, the protection of wetlands, natural and artificial communities, air, water and soil pollution and global environmental problems. Education based on pupils' creativity, in an age-appropriate way, will transmit and reinforce values that will have a positive impact on their personalities, their academic achievement and the wider environment. The cultural values of our activities contribute to the development of pupils' creativity, and to improving the conditions for the preservation, renewal, and enhancement of natural and cultural values. Teaching conservation of water resources emphasizing the value and the ecological vulnerability of lakes and wetlands requires a multi-level system approach. The principle "learning by doing" of John Dewey shall be applied, when teaching and learning is that practical problem solving, and theoretical teaching should go hand in hand, based on progressive anti-authoritarian pedagogy. Therefore, practical, real-life elements of education must be involved, such as field excursions, visiting marshlands, bird watching, angling, constructing ornamental ponds in school gardens, aquarium building and maintenance, etc. Furthermore, the use of interactive gamification based on modern information technology is particularly important in the education of this age group (6-14 years), as it actively encourages a way of thinking that involves a joint search for long-term sustainable solutions to a global problem at local level. The themes of these educational games are very compatible with the objectives of environmental education, and the topics linked to the games can be used to make the teaching of several subjects and curricula (e.g., geography - hydrography, water column; nature studies, biology - wetlands) interesting and relevant, breaking down the boundaries between subjects. Artificial intelligence supports personalised learning, continuously assesses, and provides feedback to learners and offers different learning paths based on the results of the analysis of the educational situation, i.e., it can adapt to the individual needs of students in real time.

## TITLE

## FUNCTIONAL LARGE LAKE REGIONS THROUGH THE LENS OF GOVERNANCE - OPPORTUNITIES FOR INTEGRATED DEVELOPMENT

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This presentation explores the governance of integrated territorial development based on functional regions and focuses on the large lake regions as functional spaces, presenting the results of an international research project of ESPON LAKES. The complex geographical and natural-environmental characteristics of large lake regions require a wide-ranging multi-dimensional management ability that performs equally well in vertical and horizontal coordination resulting in a real integrated territorial development. This international research project analysed the state of the integrated regional development of Lake Balaton, Lake Constance and Lake Vänern to point out areas for improvement related to regional governance and present good practices that can be exemplary for other large lake regions.

The systems operating in the studied lake regions are the results of several decades of development policy, embedded in complex governance contexts that change over time. The dynamics of the regions are different, and the challenges they have faced during their history have also been different. In the case of Balaton, a more effective integration of sectoral aspects would be necessary. In the case of Lake Constance, the focus is still on the management of discrepancies related to borders and the permeability of borders. Ensuring the consistency of planning goals and procedures across national borders remains a challenge despite decades of collaborative experience. The Vänern lake region holds many opportunities, given the still early phase of cooperation and development structures.

The comparison of Lake Balaton and lakes Vänern and Bodensee indicate that Lake Balaton and the institutional system and governance created around it over the past twenty years can serve as good practice for many European lake regions. In many respects, the challenges are different, but the coordinating role and operation of the Lake Balaton Development Council is exemplary.

## TITLE

**CLIMATE RESILIENT URBAN WATER SECURITY:  
A CASE OF BENGALURU, INDIA**

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Urban Water Security with lakes is challenging for Climate Changes. Nature based climate adaptation are emerging all over the world. This is in line with the UNCC IPCC Cop 26, 2021 and Cop 27. UN IPCC Cop26 during 2022 stipulated ten pathways for keeping the global warming to 1.5 Deg C by 2030. Some of the relevant criteria in the ten guidelines for are, 6. Changing home behaviour is an important but often overlooked climate action opportunity. 10. The cost invested on climate change control pays back. A review of the conservation and management of urban lakes based on SENCLE Model under ILEC UNEP guidelines is the session focus. A joint initiative by MoHUA, Gol, the National Institute of Urban Affairs (NIUA), and leading Indian academic institutions had 15 premier architecture and planning institutes of the country worked with Smart Cities to document the landmark projects. This effort captured the learning from best practices. Since the start of the Mission in 2015, the 100 Smart Cities have been developing a total of 7,742 projects including lakes with an investment of Rs. 1,81,500 crores.

In India, National and State Action plan on Climate Change are available since 2008. Bengaluru Urban Settlement, India is a case for review on Climate Resilient Lakes water security. In this presentation the ongoing lakes management strategy based on ILEC global and National Conservation reveal a mixed result with regard to environmentally sound technology and climate resilience. Within the statutory guidelines, there has been an improvement of water quality standards for BoD5 20 deg C and Suspended Solids. The gap between water demand and supply could be met if 54% of recycled potential were harnessed. Wastewater had enough potential (362 GL) to replace the whole centralized water supply from the Cauvery. In this presentation climate resilient water security options such as trees, open spaces, decentralized recycle and reclamation practices active for over 4 decades are listed. It is suggested that grey water treatment in feeder canals to water bodies could significantly reduce the nutrient loading's, foaming and fires at the water bodies.

Geo Spatial Temporal data for Bengaluru Urban Water Bodies reveal man made exacerbation of ecological succession leading to lake Environ quality deterioration. Report on reassessment of water quality from source to user as per WHO 2012 new mandate in the existing drinking water supply system of Bangalore is reviewed, It is found that participation of civic societies along with best natural based climate resilient case studies validation for local conditions are vital.

## TITLE

**DEVELOPING ECOLOGICAL RESILIENCE AMONG PLANKTON  
COMMUNITY TOWARDS SELECTED ENVIRONMENTAL  
VARIABLES IN LAKE MOHICAP AND LAKE PALAKPAKIN,  
SAN PABLO CITY, LAGUNA PHILIPPINES**

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In the Philippines, the importance of plankton communities as ecological indicators for assessing global changes in aquatic ecosystems has not received sufficient attention. This research aimed to explain the plankton community structure of Lake Mohicap and Lake Palakpakin. To achieve this, operational taxonomic units (OTUs), relative abundance measures, alpha biodiversity indices, and environmental parameters were analyzed alongside with the community structures at each site. Through a correlational approach, the associations between the observed variations in the plankton communities were identified. The presence of toxin-producing Dolichospermum and Planktothrix species, as well as the sole freshwater harpacticoid species in Philippine lakes and other new records from Bacillariophyta and Rotifers, have been newly documented in the study. Findings indicate that in May 2022, the high abundance of harmful algal blooms such as Microcystis outcompeted OTUs from the group Chlorophyta in Lake Mohicap. In contrast, high abundance of Aulacoseira co-occurring with Melosira had a significant decrease in the reduction of phytoplankton OTUs in Lake Palakpakin and Lake Mohicap were observed in August 2022. At the same time frame, the study recorded a dispersal or absence of zooplankton species within the plankton community. Correlational analysis indicates that seasonal changes and dynamic factors significantly influence both the composition and abundance of planktonic organisms. These changes result in a negative or non-significant relationship among environmental variables but reveal some positive associations exclusively between selected and specific OTUs found within the planktonic composition with specific environmental variables. This suggests that specific plankton OTUs are developing ecological resilience and species interactions through seasonality changes and may be able to adapt aquatic traits through resilience across environmental parameters. Thus, it is crucial to monitor plankton communities on a long-term basis, continuously explore the role of plankton communities as ecological indicators, and fully comprehend the impacts of global environmental changes and sustainable management of the two lakes.

## TITLE

## STUDY ON A NOVEL IN-SITU MONITORING TECHNIQUE FOR FAST TRACKING THE VERTICAL MIGRATION OF CYANOBACTERIAL BLOOM USING LISST-HAB

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Cyanobacterial harmful algal blooms (cyanoHABs) are becoming increasingly common in aquatic ecosystems worldwide. However, their heterogeneous distributions make it difficult to accurately estimate the total algae biomass and forecast the occurrence of surface cyanoHABs by using traditional monitoring methods. Although various optical instruments and remote sensing methods have been employed to monitor the dynamics of cyanoHABs at the water surface (i.e., bloom area, chlorophyll a), there is no effective in-situ methodology to monitor the dynamic change of cell density and integrated biovolume of algae throughout the water column. In this study, we propose a quantitative protocol for fast measurements of multiple indicators (i.e., volume concentration, size distribution, cell density, and column-integrated biovolume) of cyanoHABs in water bodies simultaneously by using the laser in-situ scattering and transmissometry (LISST) instrument. The accuracy of measurements of the biovolume and colony size of algae was evaluated and exceeded 95 % when the water bloom was dominated by cyanobacteria.

Furthermore, the cell density of cyanobacteria was well estimated based on total biovolume and mean cell volume measured by the instrument. Therefore, this methodology has a potential to be used for broader applications, not only monitor the spatial and temporal distribution of algal volume concentration, but also monitor the vertical distribution of cell density, biomass and their relationship with size distribution patterns, which provides a new technical means for the analysis of algae migration and early warning of the formation of cyanoHABs. This protocol can provide a valuable service for the monitoring, prediction, and early warning of cyanobacterial blooms in large aquatic ecosystems such as lakes and reservoirs.

## TITLE

## RESEARCH ON THE RESTORATION AND MANAGEMENT OF THE ERHAI LAKE ECOSYSTEM

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Erhai Lake, situated in subtropical plateau Yunnan Province, China, stands as the second-largest plateau freshwater lake, covering an surface area of 252 km<sup>2</sup>. It boasts a maximum depth of 20.9 m, averaging at 10.5 m, and has a storage capacity of 2.9 billion m<sup>3</sup>. With an inflow of 825 million m<sup>3</sup> and a water exchange cycle of 4.5 years, it encompasses a drainage area of 2565 km<sup>2</sup>, supporting a population of 800,000 within its watershed.

Over the past decades, the Erhai Lake ecosystem has undergone substantial transformations, characterized by a decline in aquatic vegetation, reduction in native fish species, and an escalated risk of algal blooms. Human-induced activities have led to increased nitrogen and phosphorus levels, resulting in increased algal density and a greater propensity for algal blooms. The presence of submerged vegetation plays a pivotal role in determining the lake's water quality, with a critical threshold of 17% required to sustain a "clear-water state." Thus, the restoration of submerged vegetation and the preservation of ecological equilibrium are crucial facets of the Erhai Lake ecosystem's rehabilitation.

Since 2009, an array of restoration measures has been implemented, particularly gaining momentum after President Xi's visit in 2015. These measures encompass both external strategies aimed at curbing nutrient loading from the watershed and internal interventions focused on manipulating biotic communities. Our team has actively engaged in these restoration endeavors, delving into comprehensive research on the lake's ecosystem. This includes extensive long-term monitoring of lake ecosystems, exploration of mechanisms driving ecosystem shifts, assessment of restoration techniques, experimentation with macrophyte transplantation, and more.

The culmination of these rigorous research and restoration efforts has yielded tangible results. Noteworthy improvements include enhanced water quality, a consistent expansion of aquatic vegetation distribution, a significant refinement in aquatic plant community structure, and marked increases in aquatic plant biomass and water transparency within key lake bays. Erhai Lake thus stands as a typical case study for the management and conservation of medium-depth freshwater lakes in plateau regions.

## TITLE

**SHIGA PREFECTURAL LAKE BIWA FLOATING SCHOOL**

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In Shiga Prefecture, the Shiga Prefectural Lake Biwa Floating School was established in 1983. The school provides an overnight learning experience on the ship Uminoko in Japan's largest lake, Lake Biwa. All 5th grade elementary school students in Shiga board Uminoko. This year marked the 41st year of its launch, and a total of more than 610,000 students have boarded this learning ship.

The environmental learning related to the Lake Biwa Floating School is unique in Japan in that it incorporates a series of educational content from before, during and after boarding the learning ship into the curriculum of each school as one course unit. In addition, the students on board Uminoko are from multiple elementary schools, and they stay together overnight on the ship. One of the major features of this program is that students can learn while deepening exchanges with children from other schools through the overnight trip.

On the first day, we have onboard evacuation drills and equipment tours, and a walk rally at a port of call. On the second day, we conduct "Lake Biwa learning" such as observation of organisms in Lake Biwa with digital microscopes and underwater cameras, investigation of water transparency, and learning of traditional fishing methods of Lake Biwa. We are working to foster children's attachment to their hometown, the ability to proactively relate to the environment, and the ability to interact with people through this learning. The precious experience and excitement of experiencing nature on board the ship remain in the hearts of the children as common elementary school memories of the Shiga residents who have boarded the ship. Lake Biwa Floating School is an educational program that Shiga is proud of, and it is unique to Shiga Prefecture, which is home to Lake Biwa.

Due to the aging of the first-generation Uminoko and the desire of many prefectural residents to continue the program, a new Uminoko was built and began operating as the second-generation learning ship in 2018.

This year marks the 40th anniversary of the Uminoko learning ship. During that time, children who have sailed on the Uminoko have been moved by the grandeur, beauty, mystery, and irreplaceability of nature. Children who have been moved by nature will surely love nature in the future.

We will continue to send out graduates who think and act by themselves in order to realize a sustainable society.





**POSTER  
PRESENTATIONS**

## TITLE

**DEPTH PROFILE MEASUREMENT OF SELECTED LAKES IN MALAYSIA BY USING SINGLE BEAM ECHO SOUNDER**

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Depth profile measurement or bathymetry is the study of underwater depth of reservoir or ocean floor in the different layers of depth. Accurate and updated bathymetric data is of great significance for the management and protection of the reservoir. Bathymetric surveys allow us to measure the depth of a reservoir as well as map the underwater features of a reservoir. Multiple methods can be used for bathymetric surveys including single-beam surveys. Bathymetry data is obtained from the measurement of reservoir depth through depth sounding. The data consists of latitude (x), longitude (y) and depth (z). The data is collected following established transect lines suitable for lake and reservoir study. The equipment used for bathymetry survey is single beam transducer (water depth, z value) Power and communication Module (PCM) unit (main control system for processes analog data to digital data, and connected with laptops, transducer and DGPS), Differential Global Positioning System (DGPS) (Location coordinates, y), laptops (system configuration and connection) and tide gauge (for lake water level measurement (depth correction)). All the survey data is collected and stored using Windows based HYPACK® MAX software and map of the depth profile was plotted using ArcGIS software.

This poster presents a compilation of reservoir bathymetry survey that has been carried out by Water Quality and Environment Research Center, National Water Research Institute of Malaysia (NAHRIM) at selected reservoirs in Malaysia over 2016 – 2023. Total of nine dams have been surveyed by NAHRIM include Sembrong Dam, Batang Ai Dam, Durian Tunggal Dam, Terip Dam, Bukit Merah Dam, Muda Dam, Pedu Dam, Padang Saga Dam and Upper Layang Dam. All the bathymetry data and map is useful for the reservoir authorities to have a reliable info to manage their reservoir.

The info is essential parameters in designing an efficient integrated lake basin management plan (ILBMP).

## TITLE

**CONSERVATION OF DEEPOPOR BEEL WETLAND A RAMSAR SITE: DEMOGRAPHIC CHALLENGES AND SOCIAL ISSUES**

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India is one of the 13 countries working in the IKI Living Lakes Biodiversity & Climate Project. This poster will present in more details the work plan of NEWS, the local partner in India where the project sites cover communities in the eco-sensitive zone (ESZ) around the Deepor Beel Ramsar Site and Wildlife Sanctuary in Assam.

**Background:** Deepor beel, is a large natural freshwater wetland situated southwest of Brahmaputra River near Guwahati City. It is also part of the greater elephant habitat, being adjacent to Rani Reserve forest and Gorbhanga Reserve forest. Elephants enjoy makhana, weeds and grasses in the waters of Deepor beel frequently but due to pollution in the lake there is scarcity of food for the giants. Elephants having less food now in the beel, also damages crops and thus the local communities have become disinterested to pursue agriculture. An odd group still practice it, which are locally consumed. With increase in godown, encroachments around the beel, the local tribal people find it easier to now work as menial laborer in the warehouses, and find it extremely difficult to cope with the situation. Migration, selling of land has increased which again is affecting negatively the social and ecological matrix of the region.

**Solutions:** In this situation, the livelihood and cultural – social dynamics of local communities need to be improved. Awareness exists among the local communities and they are engaged in activism mode sometimes, but cohesive actions from all the stakeholders like Governments, Civil Society Organizations, Universities, Local communities especially tribals and women are needed to bring shared vision for natural resource management of the important wetland.

The project will also sensitize and build capacity of the farmers and fishermen for sustainable and biodiversity-friendly agriculture and fisheries practices, who will contribute to the kitchen culinary of the homestay model, an USP for the pro-biodiversity tourism business. Climate change disproportionately affects female employment as well makes them more vulnerable. Gender inclusiveness is an integral part of the project. Hence, women participation in various capacity building activities will be in focus. The project will enhance capacities of local women and activate them to involve them in management of wetlands. Capacity building of the Women on alternative livelihood will give way to improved livelihood options. Involvement of Women in the Tourism management society (Cooperative/Company) will not only provide opportunities of income but it will also mainstream them in awareness for the ecosystem and also develop leadership qualities. Local youths will be trained as nature guides thus creating a pool of future generation nature enthusiasts.



## TITLE

**WATER CONVERSATIONS CRUCIAL FOR WATER CONSERVATION**

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W forW Foundation

Water management is people management and thus calls for collective action towards addressing the water worries through the abundance of wisdom available since antiquity. Any collective action is sustainable when there is trust and hope which can be built through continued communication and information sharing. Thus, water conversations are crucial to water conservation and management.

Keeping water conservation as a goal, the WforW Foundation, a citizen collective built as a think tank, initiated water conversations with scholars, policy makers, scientists, academia, authors, artists, filmmakers, activists, students, etc. on various social-ecological-technical-institutional aspects embedded in water management and governance. The one-hour online conversations namely, Wednesdays for Water, Friday Waters (Water Talkies, Book Reading, Theses Club, Water Arts), and Monday Munching/Musing with Women for Water, have completed close to 200 sessions. The process initiated a platform to learn and share the water worries and the wisdom. It also initiated a network of over 300 water enthusiasts who are regularly exchanging scholarships. Water has a connective capacity, so instead of working in silos it is crucial to communicate between the concerned, the experts, the sectors, disciplines and regions.

The conversation series is now among the longest water conversations in the country. The conversations are open-source education through YouTube videos. Essays are also developed (in progress) from the sessions for publication. The online conversations are also extended to collaborative physical water activities such as, workshops, seminars, special lectures, walks, talks, etc. Through the conversations, there is a genuine attempt to connect society and science besides pushing for conscience and common sense in order to move towards 'Making Water Everybody's Business' among 'we the people'.

The poster is a compilation made as word cloud of the topics covered, highlights, learning, and publication.

## TITLE

**WALK AND TALK URBAN LAKES: CASE OF INDIA**

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The poster is a compilation of the over 50 Lake Walks conducted in the past 10 years across different parts of India. The objectives of the 'Walk the Lake, Talk the Lake' are, 1. to better learn the complexities of the lakes in different bio-physical and social settings; 2. to share with different stakeholder groups about the bio-physical and social value of lakes; and 3. in the process document and disseminate the dos and do nots about the lake governance and sustainability.

## TITLE

**SUBAQUEOUS SOILS: A NEW PERCEPTION OF THE SOIL RESOURCE FOR THE ECONOMY OF THE AQUATIC ECOSYSTEMS**

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Among the new frontiers of Pedology subaqueous soils represent a stimulating and fundamental issues. Aquatic ecosystems play a significant role in supporting plant and animal biodiversity and the quality of the entire terrestrial ecosystem, and they also represent highly productive and economically very relevant environments in our society. They have been the subject of study of numerous disciplines in the most diverse fields of knowledge, but only in recent years they have become a matter of survey in the field of pedology and, more generally, of soil science (Balduff, 2007). Traditionally, in fact, subaqueous soils were not considered as such, but sediments, and in this limitation lay the difficulty of applying a pedological approach, and not exclusively sedimentological.

The studies of Demas and Rabenhorst (Demas et al., 1996; Demas & Rabenhorst 1999, 2001) gave rise to a new perception of subaqueous sediments, showing the scientific evidence of the existence of traditional pedogenetic processes, even in subaqueous environments. The results obtained led to a substantial evolution of the definition of soil in the Soil Taxonomy, such as to include subaqueous soils, defined as soils in conditions of permanent water saturation, at a depth that allows the growth of plants (generally 2.5 meters). This goal has been a turning point in the study of subaqueous soils that have therefore become a new topic of interest of pedology and the subject of descriptions, mapping, and study of possible management scenarios, based on the peculiar physical properties-chemical, as is the case for surface soils (Erich et al., 2010).

Playing an important role for economic and productive activities, the study of the relationships between the underwater landscape and the characteristics of the soils, aquatic vegetation, and the productivity of fish farms and breedable species, is undergoing a rapid development. In the field of ecological studies, the relationships between flora, fauna and soil in the underwater environment are still almost unexplored and are gaining a progressive importance in programs of environmental requalification and water quality conservation. From the point of view of new applications, the study of the characteristics of subaqueous soils presents an indispensable and fundamental knowledge base for new experiments in energy and technology based on the use of aquatic plants and algae. Great attention is paid, for example, to the use of aquatic macrophytes (e.g., the water hyacinth: *Eichhornia crassipes* (Mart.) Solms) for the phytoremediation of water bodies from metals, organic pollutants, to combat eutrophication and for the production of biodiesel or bioethanol.

## TITLE

**VERTICAL PROFILES OF NUTRIENTS AND CHLOROPHYLL-A IN THREE SHALLOW LAKES IN LAGUNA PROVINCE, PHILIPPINES**

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Eutrophication in lakes has been attributed to external loading of nutrients mainly from anthropogenic sources. The nutrient gradient within the water column is also important in studying eutrophication of lakes. In this study, the nutrients and chlorophyll-a concentrations in the water column of the three tropical shallow lakes Lumot Lake, Sampaloc Lake and Laguna Lake were profiled. The continuous real time logging of ammonium-N, nitrate-N and chlorophyll-a and single logging of phosphate using field equipment was conducted in these lakes of differing sizes, depths, and trophic states. Increase in chl-a in the upper water depths followed the increase of nitrate-N and the decrease of ammonium-N from a subsurface productivity depth as it approaches the surface of the lake. Maximum concentrations of nitrate-N reached up to 2.15 mg/L. Additionally, there was an increasing trend in chl-a and ammonium-N in the lower water depths approaching maximum concentrations near the lake sediment surface up to 2.45 mg/L for ammonium-N. The junction at which chl-a trends diverge showed a gradual nutrient trend in the oligotrophic Lumot Lake and a rapid change in the hypereutrophic Sampaloc Lake. In contrast, the concentrations in the water column of Laguna Lake remained relatively constant. Phosphate concentrations in the three lakes are relatively constants along the water column up to a maximum of 1.16 mg/L. The nutrient parameters phosphate as phosphorus and ammonia as NH<sub>3</sub>-N were reported at higher levels than Class C Water Quality Guideline values at 0.025 mg/L for phosphate and 0.05 mg/L at ammonia. Nitrate as NO<sub>3</sub>-N levels remained under the WQG value at 7 mg/L. Vertical profiles of nutrient gradients and the accompanying chlorophyll-a response along the water column of lakes showed that productivity, and its exacerbation due to increased nutrient loading, occurs at both surface and subsurface levels of the lake. While external loading from anthropogenic sources influence productivity at the upper levels of the water, the possible release of ammonia and phosphate from the sediment may affect the lower levels of the lake. Further exploration of nutrient loading and productivity response along the lake water column allows for new knowledge that is needed in the development of appropriate mitigation efforts in managing eutrophication.

## TITLE

**A SOLUTION TO THE PLANKTON PARADOX**

## AUTHOR(S)

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The plankton paradox, a term coined by Hutchinson in 1961, refers to the enormous diversity of phytoplankton observed virtually in all aquatic ecosystems, while a straightforward understanding of the principle of competitive exclusion, a core tenet of theoretical ecology, teaches that in competitive equilibrium a number of species competing for fewer number of resources cannot coexist. Being theoretically substantiated and empirically confirmed in most situations, however, in a minority of cases, especially in microbial communities, the principle of competitive exclusion is applicable only with some adjustments, and in phytoplankton communities it clearly contradicts empirically observed data. Hutchinson saw the solution to the problem in that varying environmental conditions prevent the formation of competitive equilibrium in a phytoplankton community. Over the past six decades, other solutions to the problem have been discussed in the literature, with an equally remarkable diversity of proposed mechanisms. While most allow the coexistence of a few more competitors in addition to what is allowed by competitive exclusion, only a few highly idealized theories allow for the coexistence of hundreds of species limited by a small number of resources.

Somewhat folkloric, somewhat under the authorship of Elton, MacArthur and others, the dominant view was that stability of an ecosystem positively correlates with its biodiversity and complexity. However, in the early 1970s, May sharply challenged this opinion, from a cybernetic perspective showing exactly the opposite. May himself, from a mathematical perspective, saw a solution to the contradiction he identified in the block structure of the community-matrix of an ecosystem. More recent numerical simulations indeed have shown lumpy distributions of species along a niche axis and the gaps between them, which actually confirms May's surmise. We hypothesize that this is the case with phytoplankton communities.

For such a lumpy assemblage of species in a community, we have constructed a hierarchical generalization of the system of Lotka-Volterra equations, consisting of connected logistic equations with a hierarchical topology of connections between them, in contrast to the ordinary case with linearly connected logistic equations.

The mathematical elaboration of the proposed generalization of the Lotka-Volterra system, similar to that done by MacArthur and Levins, Rescigno and Richardson and others in the ordinary case, exhibits a polynomial dependence of the number of species in a community on the number of limiting factors or resources, in contrast to the linear dependence in the ordinary case. In the simplest case, it reduces to a quadratic dependence. Given a dozen limiting factors and hundreds of plankton species, this is quite enough to conceptually resolve the plankton paradox.

To fully resolve the problem of phytoplankton diversity, a more substantive theory is needed that will take into account the specific physiological, morphological and ecological characteristics of phytoplanktonic species, however, we believe that the proposed mechanism completely removes the stereotype of paradoxicality from the issue.

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## TITLE

**CONSERVATION AND REJUVINATION OF BARAVS (STEP-WELLS) USING ECO-FRIENDLY MODERN TECHNIQUES AND PUBLIC PARTICIPATION IN AURANGABAD CITY, MAHARASHTRA, INDIA**

## AUTHOR(S)

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India receives about 400-million-hectare meters of rainfall annually, of which 70% of surface water is unfit for human consumption due to pollution. In water quality indices, India ranks 120<sup>th</sup> out of 122 countries. Around 2,00,000 people die every year due to inadequate water. The average annual rainfall of Aurangabad city is 725.8 mm. The potability of water is affected due to high concentration of some parameters especially nitrates, thereby needing appropriate treatment before making it available for drinking. Barav (meaning a 'constructed well' in Marathi language) is a historical heritage and traditional source of water in India. Its significance lies back in the olden days where the problem of water was managed sustainably in the areas of its scarcity. Plunging into the earth, these edifices were built in drought-prone areas to provide water to people throughout the year, ensuring a vital water storage and irrigation systems to the dependent communities. Baravs date back to more than 1000 years of existence; their neglect and decay have pushed these structures towards oblivion. Moreover, the modern water storage and distribution systems eclipsed the traditional functionality of these Baravs. Maximizing the sustainable utilization of available rainfall is a crucial and efficient strategy for conservation of water. In order to create a source of water and make it sustainable, it is necessary to do the work of water conservation at the village level more vigorously and efficiently. According to the UNESCO, India is the largest extractor of groundwater in the world. Therefore, the restoration of Baravs beholds the need of time. "Jaldoot", an NGO in Aurangabad city of Maharashtra is sincerely striving towards restoration of ground water through implementing traditional water rejuvenation activities involving the cleaning and restoration of the heritage of Baravs. Through collaboration of Jaldoot and Deogiri Cooperative Bank, Aurangabad, around 17 Baravs have been rejuvenated throughout the Aurangabad city, thereby increasing the groundwater storage and aiding to irrigation in corresponding villages. The public participation involved around 80 members of Deogiri fitness club, 40 members of Jaldoot, 30 Professors and several other volunteers assisting for achieving eco-friendly sustainable conservation and restoration of these water bodies. This contribution aims to assist achieving the United Nations 17 Sustainable Development Goals.

## TITLE

**ZOOPLANKTON OF URBAN LAKES, SUBJECTED TO RESTORATION PROCESSES**

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The catchment area of urbanized areas often poses a threat to the quality of surface water. In the case of shallow stagnant reservoirs and lakes, it usually results in an acceleration of the eutrophication process. Planktonic animals sensitively indicate about changes in the aquatic environment, such as temperature, oxygenation, trophy level, and pollution. The aim of the study was to determine the quantitative and qualitative characteristics of zooplankton communities of four eutrophicated urban lakes subject to restoration processes: Mielenko (MI), Klasztorne Małe (KM), Klasztorne Duże (KD) and Karczemne (KA). Zooplankton were collected from the epilimnion layer, from April to September in 2020-2023.

The characteristics of zooplankton communities were determined on the basis of abundance (ind/l), biomass (mg/l), number of species (n), and Shannon's diversity index (H') and Pielou's species evenness (J). The trophic state of the lakes was assessed based on the density indices and species structure of the Rotifera (Ejsmont-Karabin 2012) and Crustacea (Ejsmont-Karabin and Karabin 2013) communities.

Changes in the structure of zooplankton indicate a significant improvement in the quality of water in restored lakes (MI, KA, KD, KM). The indicator parameters of the Rotifera and Crustacea communities indicate a low eutrophy state of MI waters. The state of high eutrophy in KA waters is indicated by the high total abundance and biomass of zooplankton and the high share of bacteriophages, but the average value of the rotifer index corresponds to a low level of eutrophy. The state of high eutrophy of KD waters is indicated by rotifer indicators based on the assessment of the share of eutrophic species, including *K. tecta* and the bacteriophage community. The quantitative and qualitative structure of Crustacea indicates the state of high eutrophy of KD waters due to the values of the total number of crustaceans and the biomass of Cyclopoida. The values of the remaining groups of indicators indicate a wide range from mesotrophy to low eutrophy of KD waters. The average value of the crustacean and rotifer index corresponds to the level of low eutrophy of KM waters.

## TITLE

**CHANGES IN STAKEHOLDERS' ACTIVITIES FOR THE REMOVAL AND MONITORING OF INVASIVE ALIEN AQUATIC PLANT IN LAKE BIWA**

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The invasive aquatic plant, *Ludwigia grandiflora* subsp. *hexapetala* was first identified in Akanoi Bay, located on the southeastern coast of Lake Biwa, in 2009. At the time of its discovery, the plant covered an area of approximately 142 square meters. However, by March 2012, when fishermen noticed the issue, the growth area had expanded to approximately 4,200 square meters. Concerned environmental NPO, local fishing cooperatives association, university student NPO, network group in the city of Moriyama, and a council in Shiga Prefecture join forces to address this problem. This report introduce the changes in stakeholders' activities through interviews surveys.

As a results of the survey, their activities for the removal of *L. grandiflora* in Akanoi Bay were categorized into four periods based on the level of activity after its initial identification in 2009:

1. Early Phase - 2009 to 2011: During this period, *L. grandiflora* growth was confirmed, and experts were monitoring the situation, but local residents were not yet aware of the issue.
2. Initiating Phase - 2012: In 2012, residents began to feel concerned about the proliferation of *L. grandiflora*, and activities such as assessing the situation and removal efforts commenced.
3. Active Phase - 2013 to 2015: During these years, the number of activists increased, student organizations actively engaged in activities, and removal efforts intensified.
4. Convergence Phase - 2016 and beyond: From 2016 onward, the growth area of Water Hyacinth decreased, and the focus in the community shifted towards monitoring activities related to this species.

In these activities, a local NPO dedicated to water environment issues and firefly conservation played a central role in connecting various stakeholders and expanding the initiatives. During some periods of these activities, funds were raised through crowdfunding and used to expand the initiatives. Among them, student groups gathered not from local residents, but from all over Japan, and actively worked to solve the problems in this area. The NPO autonomously planned, prepared, and carried out eradication activities, significantly increasing the number of participants. Additionally, the group also developed its expertise in extermination activities under the guidance of specialists.

## TITLE

## REPORT OF THE EVENT FOR CHILDREN TO LEARN ABOUT ENVIRONMENT THROUGH NATURE HIKE IN THE BASIN OF LAKE BIWA IN TAKASHIMA-CITY, JAPAN

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Lake Biwa known as the third oldest lake in the world and the largest lake in Japan was born about 4 million years ago.

There are not only over 1700 fauna and flora, but also over 60 endemic species in and around the lake. In addition, people lived on water from Lake Biwa, spring water, and fish from rivers and Lake Biwa until half a century ago. However, the ecosystem has been adversely affected due to global warming or Lake Biwa Comprehensive Development implemented from 1972 to 1996. The regional urbanization, river modifications, and alterations to Lake Biwa itself led to the disruption of the natural balance in the region.

Moreover, opportunities for children to play in nature and research through experiments in nature are diminishing.

We, Ivusa, held ["Let's become a researcher of Lake Biwa tour"] to make children emerge inquiring minds through field-working, experiments and presentations around Lake Biwa with college students.

This summer in 2023, we are organizing the [Mountain Expedition in Takashima] event, and we aim that children think about what is needed to conserve Lake Biwa, by visiting people who live and use mountain spring water and groundwater in the base of the mountain, and learning the relationship between forest, creatures, and water in this event.

In there, we are going to play around a river to get close to creatures, do quiz games about the mountain and experiment by using handmade filtering devices to watch a filtering function of a mountain.

We will exhibit the report of this event at the World Lake Conference.

## TITLE

## BENTHIC MACROINVERTEBRATE COMMUNITIES IN THE LITTORAL ZONE OF GREEK LAKES

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The Greek natural lakes are discerned, according to their depth, into three categories: deep lakes (GR-DNL, mean depth >9 m), shallow lakes (GR-SNL, mean depth: 3-9 m) and very shallow lakes (GR-VSNL, mean depth < 3m). The objectives of the study are: a) to present the benthic macroinvertebrate communities in the Greek natural lakes and evaluate the lakes' ecological status according to WFD provisions and b) to investigate potential differences in benthic macroinvertebrate communities in the three lake categories according to lake depth. In the present study, we examined 23 lakes. Six lakes belonged to lake type GR-DNL, nine to GR-SNL and eight to GR-VSNL. The number of sampling sites in each lake was selected according to lake size, available habitats and accessibility, ranging from 1 (Lakes Ismarida, Stymfalia) to 13 sites (Lake Trichonida). Benthic macroinvertebrates samplings were carried out during spring season, from 2018 to 2022. In total, 105 sampling sites have been surveyed for benthic macroinvertebrates, using the three-minute kick/sweep method with standard hand net (500 µm mesh size) at the lake littoral zone. Macroinvertebrates were identified to family level except from oligochaetes, which were identified as class.

A data set of average benthic macroinvertebrates taxa abundance of the sampling sites per lake was constructed for all calculations. The Hellenic Lake Littoral Benthos (HeLLBI) assessment method was applied for the classification of lakes' ecological status. Non-metric multidimensional scaling (NMDS) and one-way analysis of similarity percentages (SIMPER) were applied to visualize similarities and identify the taxa responsible for the discrimination in benthic macroinvertebrate community structures among different lake types.

In total, 76,374 individuals were collected and 72 taxa were identified. Five taxa comprised 90% of the collected individuals: Corixidae, Gammaridae, Chironomidae, Oligochaeta and Asellidae (55%, 13%, 12%, 7% and 3% respectively). The highest average number of taxa were observed in Lake Dystos (15 taxa) and the lowest in Lake Kourna (5.42 taxa). The lowest average number of individuals was recorded in Lake Voulkaria (117.5 individuals) and the highest in Lake Karla (3,704 individuals). According to HeLLBI, ten lakes were evaluated as good, nine lakes as moderate, two lakes as high (Lakes Dystos and Voulkaria) and another two lakes as poor (Lakes Ismarida and Zazari).

The NMDS plot provided a useful display of the actual multivariate distance among lakes (stress value: 0.16). Benthic invertebrate assemblages showed separation according to lake depth. According to SIMPER analysis, the average dissimilarities between deep and very shallow lakes and between deep and shallow lakes were 63.93% and 51.30%, respectively, mainly due to high percentage dissimilarity contribution of Gammaridae and Corixidae. The average dissimilarities between shallow and very shallow natural lakes were 61.89%, as a result of high percentage contribution of taxa Corixidae and Oligochaeta.

## TITLE

**MORIYAMA CITY, THE CITIZENS LIVE WITH FIREFLIES**

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Akanoi

In Japan, we have loved fireflies for long time ago.

There is famous three types of fireflies in Japan.

One type of them is "Genji botaru".We can see many fireflies in Moriyama city, where is along the biggest lake in Japan.There is famous for the habitat of "Genji botaru(Luciola cruciate)". Citizens had presented them for the Japanese emperor since about 1900.However, number of fireflies has decreased since 1950.Therefore, the project that increases its number have begun in 1979.In 1990, firefly museum of Moriyama city constructed as a symbol of the city, where is famous for fireflies.

There is the artificial river and laboratory.Here we study aquafarming fireflies and have fireflies and shells to feed them.

In 2000, an ordinance for fireflies came into force to protect them.

One the other hand, citizens have been worked, too on increasing firefly for 30 years. Such as, checking river water quality and counting number of fireflies. Fireflies can be seen from May to June in the river of Moriyama city.

We hold the firefly festival at this time of the year.

## TITLE

**UNIVERSITY STUDENTS REMOVE AN INVASIVE ALIEN AQUATIC TO SAVE BEAUTIFUL AND WEALTHY LAKE BIWA WITH GOVERNMENT AND LOCAL FISHERMAN IN THE REED PLANTATION AREA OF KUSATSU CITY**

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Lake Biwa, one of the largest lakes in Japan, located in Shiga Prefecture, has been loved by people since ancient times due to its beautiful scenery and diverse life forms, and the fishing industry and other industries have been passed down through the generations. Especially endemic species of Lake Biwa, such as Biwa-masu(Biwa salmon) and Koayu(Small sweetfish), have been familiar with the residents of the prefecture and people throughout Japan.

These fish spawn and grow in the inland lakes and reeds of Lake Biwa. In recent years, however, an invasive alien aquatic plant known as Water primrose *Ludwigia grandiflora* subsp was found in Akanoi Bay in the southern basin of Lake Biwa(Moriyama City, Shiga prefecture),it has been characterized by explosive growth and propagation, in 2009 with the coverage area of water primrose is 142 m<sup>2</sup>. In 2016, the coverage area of water primrose reached some 300,000 m<sup>2</sup>, spreading all over the southern basin of Lake Biwa.The water primrose causes serious adverse effects such as the deterioration of the lake's scenery and destruction of its ecosystem.

The problem is becoming more serious as the fishermen engaged in the removal of these water primrose are also facing a labor shortage due to the aging of the fisherman.

Water primrose particularly remains in reed plantation areas, and it is necessary to carefully remove roots and stems remaining underwater or underground by hand, and a lot of manpower is required to completely remove them.

In the reed plantation area in Kusatsu City, where is the shore of the southern area of Lake Biwa, water primrose has been growing heavily, taking away fish habitat and having a negative impact on the fishing industry of local fishermen.

In response to this problem, IVUSA planned a removal activity for three days from September 11 to 13, 2022, and collaborated with the local government and fishermen to remove the water primrose. As a result, water primrose with a total weight of 30 tons and area of 2,000 m<sup>2</sup> was removed for 3 days.

In this removal activity, we were appreciated by not only local fisherman but also the Governor of Shiga prefecture. In terms of the chances that students were able to communicate with many people concerned, the result of this activity was not only the total weight or area of removed water primrose.

In this poster, we will highlight the method and results of the removal activities in Kusatsu City, as well as the positive effects on the regaining of the ecosystem balance and fishery activities that have resulted from the periodic removal of the water primrose.

## TITLE

## CLADOPHORA AS ECOLOGICAL ENGINEER: A NEW TEST FROM THE LARGEST LAKE OF QINGHAI- TIBET PLATEAU WITH FILAMENTOUS ALGAL BLOOMS

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Filamentous algae blooms (FABs) have been increasing globally in recent years, and their massive biomass can have significant harmful or beneficial effects on the aquatic ecosystems. As one of the most common FABs, Cladophora bloom has been reported in lakes of Qinghai-Tibet Plateau during past years. However, there have been few studies focused on how FABs impact other aquatic organisms, especially in those alpine lakes since these aquatic ecosystems are at the forefront of responding to global climate change. In present study, the phytoplankton community in different regions and seasons of Qinghai Lake were profiled using meta-barcode sequencing. The phytoplankton assemblages in areas with Cladophora bloom were compared to those in areas without Cladophora growth. The phytoplankton community were mainly correlated with physicochemical properties such as water temperature and electronic conductivity, nitrate, and Cladophora biomass. The relative abundance of Bacillariophytes was found to be higher in Cladophora blooming zone than in other regions. Significant seasonal change in phytoplankton biomass and  $\beta$  diversity were observed in the Cladophora blooming zone. The growing and microbial degradation of massive Cladophora can change the regional pH, dissolved oxygen, sesshi depth, and nitrate. Together with seasonal temperature changes and regional EC changes, Cladophora growth can significantly impact the biomass, community dissimilarity and assembly process of phytoplankton. The present results proved that Cladophora as an ecological engineer plays a key role in littoral aquatic ecosystems.

## TITLE

## FROM CHARACTERISTICS OF AQUATIC POPULATIONS TO ECOSYSTEM FUNCTIONALITY MAINTENANCE: THEORY AND CASES

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The content begins with a review of fundamental ecological theories concerning populations and communities. Subsequently, two research cases on aquatic organisms are introduced. The first case centers around the restoration efforts of aquatic plants in Lake Erhai, highlighting the crucial role of ecological niches, community construction, and stability in determining ecosystem functionality. The second case delves into the interactions between phytoplankton and zooplankton in the context of climate warming and eutrophication. It unravels intricate nutrient coupling and size structure alterations, as well as compensatory effects on ecosystem functionality. These studies furnish scientific underpinnings for the management and conservation of aquatic ecosystems, offering valuable insights for addressing forthcoming environmental changes and challenges.

## TITLE

**REHABILITATION OF “FLOWING ROPE WITH BIRDLIME HUNT” AND “WIDE RECTANGLE NET HUNT” TO WATERFOWL**

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“Flowing rope with birdlime hunt” and “wide rectangle net hunt” were performed at Tega marsh (Chiba) and Kasumigaura lake (Ibaraki) until 1945, legitimately. There were also cases at Sado island (Niigata, Japan sea) and Biwa lake (Shiga). The role of the public museums of Ibaraki Prefecture and Sado city (Niigata Prefecture) is big in folklore after new political system from 1945. There is preceding study from natural history, folklore and land water science. The presenter analyze current state and problem for rehabilitation.

## TITLE

**EFFECT OF LIGHT AND WIND ON CELL AGGREGATES AND COLLECTIVE UPWARD MIGRATION OF DIFFERENT MICROCYSTIS SPECIES: EMPHASIZE ON THE ROLE OF EXTRACELLULAR POLYMERIC SUBSTANCES**

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In the context of global climate change and increasing anthropogenic pollution, Microcystis has the potential to proliferate and form dense surface blooms under specific environmental conditions. This phenomenon significantly degrades water quality and poses substantial harm to aquatic ecosystems. However, many studies focus on the floating process on the larger size of Microcystis colonies associate with higher buoyancy, but the potential exist rapid floating upward mechanism of single cell under certain environmental conditions is not clear.

In this study, we selected two different kinds of single cell species (*M. aeruginosa* and *M. wesenbergii*) and compared their floating process and different response under strong light stress and small wind conditions, mainly emphasize on the role of extracellular substances released by Microcystis in the formation of surface bloom. Our findings revealed that *M. wesenbergii* exhibited a greater propensity to form surface blooms compared to *M. aeruginosa*, particularly under strong light conditions. This distinction could be attributed to the significantly higher levels of soluble extracellular polymeric substances (proteins and polysaccharides) found in *M. wesenbergii* as compared to *M. aeruginosa*. Additionally, *M. wesenbergii* contained an abundance of functional groups, which facilitated the formation of agglomerates.

The results indicated that the formed micro-bubbles and S-EPS secreted from the *M. wesenbergii* was the main reason for the algae to floating up and accumulate at the water-gas interface. This discovery presents a novel perspective on the formation of surface blooms and offers insights into potential strategies for managing cyanobacteria in eutrophic water bodies.



## TITLE

**USING REMOTE SENSING AND GROUND-TRUTH MEASUREMENTS FOR CATCHMENT BASED ADAPTATION OF VEGETATION INDICES**

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Remote sensing is an important data source for researchers to correctly account for the spatial and temporal variability of vegetation, however, reliability of data requires ground truth measurements. The aim of the present study was to investigate vegetation indices and their role in the soil-plant-water system in a small agricultural catchment. Four land use types of forest, grassland, vineyard, and cropland (with crop rotation) were investigated. These four land use types cover about 85% of the total catchment area. In the vineyard, there were three different inter-row management: grassed (G), cover cropped (CC), and tilled (T). Slope position can greatly affect plant growth mainly due to differences in soil physical and chemical properties resulting from soil erosion processes, or radiation exposure due to elevation changes. Therefore, the study also investigated the influence of slope position through lower and upper measurement points at each study site. Spectral reflectance sensors were used on the slopes of grassland, cropland, and all three vineyard sites. Hand-held instruments were used to measure NDVI, chlorophyll concentrations, and Leaf Area Index (LAI). We used spectral reflectance sensors on the slopes of grassland, cropland, and all three vineyard sites. Normalized Difference Vegetation Index (NDVI) and Photochemical Reflectance Index (PRI) sensors were used to measure leaf reflectance. A hemispherical sensor set was used for each measurement. The field data collection took place between 2021 and 2023. The source of the satellite data was Sentinel-2 multispectral images. The satellite-based vegetation indices were NDVI, green (GCI) and red edge (RECI) chlorophyll indices, soil-adjusted vegetation index (SAVI), and Enhanced Vegetation Index (EVI). Satellite data were collected during vegetation periods between 2020 and 2023. We found that the land use types strongly influence vegetation growth. The highest overall NDVI values were observed in the forest samples, and the lowest in grassland. Satellite based SAVI data were significantly different for samples from different land use areas ( $p < 0.05$ ), except for the vineyard (as the average of the three sites) and grassland samples ( $p = 0.58$ ). NDVI data from field measurements showed a very strong correlation between Sentinel-2 retrieved vegetation indices. The strongest correlation was found between the field measured NDVI and Sentinel-2 GCI samples ( $r = 0.95$ ,  $p < 0.05$ ). The different sources of NDVI samples were not significantly different between upper and lower slope positions ( $p > 0.05$ ). Overall, we found that remote sensing data require ground measurements to be validated, however, afterward it allows us to study the spatial and temporal patterns of our sites.

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