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31 YEARS OF ENVIRONMETAL EDUCATION

INVASIVE SPECIES IN THE GALICIAN TERRITORY

THE LIVINGRIVER PROJECT: A HOLISTIC APPROACH

THE EFFECTS OF CLIMATE CHANGE ON EARTH'S WATERS

DIGITAL & TECHNOLOGICAL SOLUTIONS FOR PROTECTING RIVERS

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LAND STEWARDSHIP

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LAND **STEWARDSHIP** <u>Page #4</u>

LIS RIVER

<u>Page #7</u>

HYDROGRAPHIC BASIN



TECHNOLOGICAL SOLUTIONS <u>Page #10</u>



INVASIVE SPECIES IN THE GALICIAN TERRITORY <u>Page #12</u>

THE LIVINGRIVER PROJECT <u>Page #14</u>





CLIMATE CHANGE **ON EART'S WATERS** <u>Page #16</u>

















Campo do Tea Volunteering (Custody Project)



Due to the questionable results of the management of the territory by the Administration, land stewardship projects such as the Tea Project, a plan carried out by ADEGA and other entities, cure the Tea River.

WHAT IS THE LAND STEWARDSHIP?

It is a strategy of conservation of the natural, cultural and landscape heritage. The main characteristic is the citizen awareness in the responsible management if the land of stewardship (councils, associations, etc.) by different kinds of agreements. For years many experiences of stewardship started through this tool.

Basora and Sabaté (2006) define it like "a set of strategies and instruments that aim to involve landowners and users of the territory in the conservation and good use of natural, cultural and landscape values and resources. To obtain it, they promote agreements of continue collaboration between owners and entities of custody."

WHAT ARE THE CUSTODY AGREEMENTS?

One of the key words of this should be "trust". In fact, the custody agreements are volunteer process between owners and custody entities, verbal or write agreements Custody entities, on the other hand, are public or private, non-profit organizations that work in the conservation of the natural and cultural heritage. The Custody agreements can be with transfer of management or without it. Management transfer agreements are those in which the custodian carries out the partial or total management of the property and in which it must also ensure that the agreements reached are monitored. The legal options of this modality are the lease of rights of felling, pasture and others, the cession of the use, the transmission of real rights and the servitudes, the usufruct, the confidence and transmission of the property by donation, purchase, exchange or legacy.

RIVER ADOPTION AND STEWARDSHIP

River adoption and river stewardship are options for citizen participation in the environment. They involve devising and developing initiatives that serve to improve or preserve the state of the river.

Depending on the performance, its intensity and duration, we can talk about river adoption or river stewardship.

Through specific actions, such as carrying out a clean-up or an inventory of flora and fauna, which do not imply continuity in time, we will be developing a river adoption. However, if the actions require management agreements with owners or concessionaires, the project should be formalized in an agreement (land stewardship agreement) and therefore we would be talking about river stewardship.

River stewardship is a form of land stewardship linked to river and aquatic ecosystems (rivers, lagoons, wetlands, ponds). It can be public or private, and can be managed directly (in whole or in part) by a single custodian entity, by more than one entity, by one or more public administration bodies or, on occasion, by volunteers.

RIVER STEWARDSHIP ON PHD

River stewardship has the peculiarity that most of the areas in which it will act have no owner, but are Public Hydraulic Domain (PHD). This implies that they belong to the company as a whole and therefore there are no owners with whom to enter into agreements.

It would be, therefore, the competent administration with whom we would have to sign agreements. However, agreements can be reached with people who own property on land that is beyond the DPH and thus act indirectly on a stretch of river.

Thus, for example, agreements can be established with residents to perform tasks of elimination of invasive alien species, thus minimizing their arrival on the banks of the river, or also facilitate the recovery of the riparian forest to give connectivity to the river. Likewise, a mill can be recovered as an ethnographic element or bat shelters can be established.

Another option is to reach agreements with other users of the Public Domain, such as fishermen's associations or irrigation communities, who can collaborate on conservation and monitoring initiatives.

A MANUAL FOR RIVER STEWARDSHIP

This manual created by ADEGA tries to be a useful tool for promote initiatives. It is focusing to all the people who has interest in participate by active way for the protection, conservation and improvement of the river and wetlands.

Another reason has to do with the fact that, within the levels of participation of volunteers in the Rivers Project, the possibility of acquiring a higher level of commitment is contemplated that allows to carry out concrete actions of improvement in the chosen stretch of river.

There are participating entities that have already spent time carrying out inspections and have other concerns about their stretch, in which they detect problems, threats or needs that they know better than anyone.

With the help of the manual, these environmental volunteer groups can carry out more or less complex activities, which are coordinated by themselves with the support of the Rivers Project team.

LIS RIVER HYDROGRAPHIC BASIN & **31 YEARS OF ENVIRONMENTAL EDUCATION**

Knowing, valuing and intervening Mário Oliveira; Olga Santos (Polytechnic of Leiria, Portugal) mario.oliveira@ipleiria.pt; olga.santos@ipleiria.pt

Lis River hydrographic basin (hereinafter referred to as BHL) with approximately 945 Km2 (LeiriaPolis, S.A., 2001), belong to the "hydrographic region 4" and is located in the central coastal region of Portugal. Lis river, the main watercourse in this hydrographic basin, has its source near the village of Fontes, at an altitude of 400 meters, and runs 39.5 km to Praia da Vieira, where it flows into the Atlantic Ocean. Despite its small area, BHL is fertile in environmental problems (Campar et al., 1989), making it a preferred territory for the development of environmental education initiatives and projects.





Elimination Exotic Invasive Flora no River Tea

For the period between 1990 and 2020, using the study developed by Riqueira (2012), the analysis of application processes and reports on the execution of environmental education projects developed by a regional NGO, Oikos - Associação de Defesa do Ambiente e do Património da Região de Leiria (Oikos – Association for the Defense of the Environment and Heritage of Leiria Region), as well as news related to environmental education initiatives published in the local/regional written media, it was possible to perceive the typology of 14 education projects developed in the BHL, as well as the methodologies used and resulting products.

BHI

The project "Recolha de Água na Bacia Hidrográfica do Lis – Projeto de monitorização" (Water Collection in the Lis Hydrographic Basin - Monitoring Project) was developed throughout the 31 years analysed and, through this project, teachers and students have the possibility to visit 15 locations of BHL, collecting samples of water from rivers and streams, which are analysed by accredited laboratories in terms of fecal contamination, organic contamination, nutrients, heavy metals and other metals. These analytical results are made available to schools, the media and entities managing water resources and public health. This project, as well as a book edited within its scope (Carvalho, Oliveira & Pedroso, 2011) continue to be the base for other environmental education initiatives and projects related to BHL.

The analysis of a set of 12 other projects carried between 1996 and 2006 allowed to understand that, over this time, and in a progressive and complementary way, the approaches to water resources and to BHL have been diverse. Thus, the school community, but also the population in general, had the opportunity to get involved in initiatives that allowed to know and monitor the hydrographic network, study the evolution of the relationship between human occupation and rivers and their banks, contribute to conserve and publicize the importance of BHL, as well as gain the capacity for intervention and political reaction in a more environmentally enlightened way. As a result of these projects, a wide range of pedagogical and didactic materials were edited and distributed free of charge to the population, such as a book dedicated to the Lis river and its monitoring project, collections of slides and respective guides for interpretation and pedagogical exploration, posters, exhibitions, booklets, brochures, puzzles, postcards, bookmarks and stickers. One of these projects was particularly relevant since, among other initiatives and production of materials, it allowed the development of nurseries of riparian species which, later on, and in a partnership with entities responsible for the management of rivers and streams, allowed the school community to intervene in the recovery of riparian galleries of rivers and streams in its area of influence.



BHI

Lastly, we highlight the project "Lis: Velho Rio ComVida" (https://riolis.ipleiria.pt/), which aimed to contribute to the recovery and sharing of experiences associated with Lis river, from its source to its mouth, through a wide range of intergenerational initiatives, expanding the knowledge of this watercourse by different generations of inhabitants on its banks, as well as contributing to a higher involvement of the entire community in its recovery, preservation and enhancement, taking into account its value as a natural, but also cultural, heritage of the entire region it crosses (Oliveira et al., 2012).

🚺 lis: velho rio con'vida

In short, the analysis of these 14 projects allowed us to realize the importance of combining typically quantitative work methodologies with others of a qualitative nature, enriching environmental education initiatives subordinated to rivers and their hydrographic basins. Likewise, it is evident the importance of the initiatives to be though from an intergenerational and inclusive perspective, going beyond school boundariesand opening them to the general population.



BHI

DIGITAL & TECHNOLOGICAL SOLUTIONS FOR CARING & PROTECTING RIVERS

Tuncay Sarıtaş, Caner Börekci

Today's science and technology allows us to better understand and seek solutions to major global problems such as the accelerating climate change, the increasing frequency of natural disasters and the declining of freshwater resources. There is an urgent demand to solve these problems. Thanks emerging innovative technologies!

Utilizing digital technologies such as Artificial Intelligence (AI), and sensor networks might particularly be beneficial for addressing the unique problems and challenges in caring and protecting rivers.



ARTIFICIAL INTELLIGENCE (AI)

Al is a technology that performs tasks normally requiring human intelligence (e.g., visual perception, speech recognition, decision-making). Systems programmed with AI use pattern recognition mechanisms to "learn" as they receive new data inputs, replicating some of the sophistication of human learning (Nilsson, 2014). Within this scope, Al technologies offer potential benefits for sustainable water management including forecasting the availability of water resources (e.g., rivers) under changing hydrologic and climatic conditions. Al-enabled platforms can also provide us with predicted data for water consumption and quality in the following years. These platforms enable consumers to be educated and aware of the protection and caring of rivers (ELI, 2019).

SENSOR NETWORKS

Sensor networks provide a promising infrastructure for numerous control and monitoring variables including pressure, temperature, pH, pollution, flow rate, equipment performance and more. These simple low-cost networks allow monitoring processes at a distance, in real-time and with minimal human intervention (Pule, Yahya & Chuma, 2017). Moreover, this infrastructure allows for the study of an area, namely, a water source, over time and at close intervals. This approach has since promoted pro-active response to contamination of rivers.

Some examples for the use of technology in protecting rivers:

XIN'AN RIVER ICT PROJECT

A project for protecting Xin'an River and other water ecosystems within the Yangtze River Economic Belt in the People's Republic of China (PRC) by Cities Development Initiative for Asia in 2019. The project demonstrated the benefits of networked, real-time monitoring of industrial parks and manufacturing enterprises to reduce the risk of water pollution. It also highlighted the cost-effectiveness and the advantages of data sharing and integrating separate ICT systems into Huangshan's Smart City platform. Doing so reduces the risk of information isolation in key environmental areas and helps improve monitoring and emergency response. The data collected within the project in the Smart City platform are linked with other data sources especially for data analytics to be shared, thereby monitoring and risk prevention (Development Asia, 2021).

JÄRVIWIKI PROJECT

Järviwiki project, funded by Finnish Environmental Institute (SYKE), was conducted to share information and knowledge about lakes, rivers and marine environments across Finland while raising awareness and advocating for aquatic ecosystems. Järviwiki is a public platform that allows citizens and researchers to upload qualitative and quantitative data about lakes and waterways across Finland. Citizens collect information, data and photos from specified sites and upload them onto the platform. This information can include plants, animals, algae, temperature, ice cover, water level and other aquatic characteristics. Järviwiki has been integrated into a cost-efficient model designed to improve monitoring and management of river basins in Finland.



Sensor network. Photographed by Bryan Downing, U.S. Geologyst.

MACKENZIE DATASTREAM PROJECT

The Mackenzie River is the longest one in Canada. Climate change and expanding the basin have created major concerns about the impacts on river health, permafrost melting and drinking water safety for local communities (Mackenzie DataStream, 2018). A clear concern was the need to understand water quality in the basin to protect communities, cultural traditions and fresh water.

Mackenzie DataStream was designed to promote education and collaboration between communities, researchers and governments through community-based monitoring and open data, and to create evidence-based decision making. There are 24 communities that monitor over 70 parameters within the Mackenzie River basin and upload their data onto the open-access platform. Within the Mackenzie DataStream platform, there are data visualization tools that help to unveil water quality across the basin. These features allow researchers, citizens and decision makers to explore and understand the basin's health and function.

INVASIVE SPECIES IN THE GALICIAN TERRITORY

Amador Ordoñez, Aroa Alonso

The region of Galicia, in north western Spain, has always enjoyed a rich natural diversity. The ecosystems present in its forests, rivers and seas made a difference years ago and served as a livelihood for many families who were engaged in forestry and fishing.

However, increasing human activity and the arrival of invasive species endanger this diversity, and therefore the survival of many other species.

These are just some of the most common invasive species in Galicia:







Ending these types of species is a time-consuming process that has started years ago and continues in the present time. Various measures have been implemented to confront harmful invasive species in Galicia, but we highlight some of the most important ones:

- Control of exotic and invasive flora.
- Elimination of plantations of non-native species. •
- Planting of native species. .
- Improvement of the phytosanitary status of river corridors. ٠
- Dissemination of natural values, socioeconomic benefits and ecosystem services provided by rivers. ٠
- · Improvement of the training and technical qualification of the agents involved in the management and conservation of rivers.

There are some cases like the LifeFluvial project (LIFE 16/NAT/ES000771), which have been implemented in our territory and focuses on improving the sustainable management of the river corridors of the Atlantic-Iberian region.

These actions are crucial to preserve Galician flora, as its nature is the most famous characteristic of this land. Invasive species have led to irreparable situations, like land drought caused by eucalyptus or massive death of fish due to the introduction of some invasive water plants. Ecosystems are being affected by humans not just by polluting and altering natural cycles, but also by introducing species that contribute to the disappearance of many species. Let's act consciously.





A holistic approach Luisa Seixas, Sofia Diniz (HTC NOVA FCSH / CFE)

Our participation in the Living River project has been very rewarding, and we have been learning a lot collaborating with the project's partners.

As a team, it is our mission, as researchers and citizens, to put our tools at service for the greater good and for the benefit of all. The Living River project has constituted a space for experimentation, dialogue and research about the importance of memory and history for the knowledge of rivers and streams.

We won't say it has always been easy: research and collaboration are challenging tasks, ones that always come with the unexpected aspects of creating new paths and new approaches. Simultaneously, these are aspects that bring the excitement of starting something new, of meeting new people and areas of expertise, ones that bring new light over the way researchers often close themselves into the academy, in a frequently lonely course of action.



Group photo of the Teacher Training in Coimbra, october 2019 (photo credit. LivingRiver Project, 2019)

During our participation in the project, communication and dialogue have represented two great areas of work. The aim of this project is to create bridges between the knowledge produced in the academic ground and the general public, specifically schools. Working with our partners from NGOs and the teachers from the different schools has been very important, challenging our preconceptions and ideas of what is useful and coming to terms with something that may be of interest to students and teachers. Communicating what we love in science and making it available and accessible has been a very central and important task during the course of Living River. Dialoguing with our partners has helped us better understand what we do, why we do it and how we can challenge ourselves to make better and more relevant content.

It is also important to note how much we have learnt with our partners from the University of Coimbra. In this project, we had the opportunity to work together with the areas of biodiversity and biology and how our subjects can inform each other, creating a more holistic approach towards heritage and biocultural diversity. It is not so common (although very desirable) to find colleagues from other scientific disciplines with whom to discuss, learn and grow, sharing ideas and questions and broadening our scope of understanding. Ways of doing, ways of looking and questioning the world are different, but if shared, may bring such new approaches towards life on this planet.



Webinar with the Brasov Metropolitan Agency for Sustainable Development (Romania) associated teachers, November 2020 Photo credit: Sofia Diniz, 2020.

Finally, a note on some personal aspects: Living River has allowed us to experience new places and find new ways of looking at the contemporary world in a unique way. Travelling and learning about other cultures in the company of our partners were aspects of this project which also made us richer. Despite the challenges of the recent events related to the Covid-19 pandemics, taking part in this project has been an enriching experience, not only scientifically but also humanly.

THE EFFECTS OF CLIMATE CHANGE ON EARTH'S WATERS

Diana Simileanu, Mihaela Dăineanu

A topic very intensely discussed and studied since the last century, it has generated initiatives for the implementation of the measures listed in studies, projects and programs, worldwide.

Researchers have given up using the phrase global warming and adopted the phrase climate change because it is an all-encompassing notion, which refers to both the phenomenon of global warming itself and its devastating effects. Today we will stop at some general introductory notions, after which we will talk about this phenomenon referring to the situation in Romania. Global warming is a phenomenon of continuous increase in average atmospheric temperatures, recorded in the immediate vicinity of the soil, but also the continuous increase in ocean water temperature. Although this phenomenon has always existed in the history of the Earth, in the last two decades this phenomenon has accelerated, causing concern among researchers, governments and the conscious population.



Photo source: ©AP Images/European Union 2018 - EP.

Experts in the field claim that, in the second half of the last century, the increase in temperature is due to the high level of greenhouse gas concentration, a phenomenon generated by direct and indirect human action. Natural phenomena (solar variations, volcanic activity) had only a small warming effect, until 1950.

Torrential rains and other extreme weather events are becoming more frequent. As a result of this situation, floods occur and water quality decreases, and water resources become increasingly precarious in some regions. It is already known that climate change has profound effects in various areas and continues to cause sea levels, climatic extremes, melting glaciers, the extinction of many species, changes in human health.

Climate change has been observed in Europe in the form of higher temperatures, changing rainfall and runoff patterns, as well as extreme weather events, leading to reports of an increased incidence of weather disasters. (World Bank Report. Monitoring the Effects of Climate Change and Risks in Romania).

Rising Black Sea levels due to climate change is a cause for concern. The observed impact of climate change in Europe is: a global rise in sea levels in most coastal areas; changes in freshwater systems, such as a decrease in river flows in the south and east and an increase in reported floods. Romania has estimated that the Black Sea level will increase by 12-25 mm / year or up to 0.5 m by 2050, according to a negative scenario. The Black Sea is almost a closed sea and has relatively low salinity and tide levels. However, when the intensity and frequency of rapid floods and rainstorms are added, there may be coastal erosion, loss of freshwater flora and fauna, and significant damage to coastal infrastructure and settlements. (World Bank Report - Monitoring the Effects of Climate Change and Risks in Romania).

The ecosystem of the Danube River and that of the Danube Delta are also obviously affected by upstream changes, pollution and water management that are discharged, sediment runoff into the Danube. The Danube Delta will be significantly affected by the increase in the average annual temperature and the increased frequency of extreme weather events. The air temperature will increase on average by 1.5 degrees Celsius by 2050, which will lead to increased evaporation, extremely hot days and a significant decrease in the snowy period. Dangerous meteorological phenomena such as severe droughts and high temperature peaks, extreme floods, wind gusts, rains, storms, hail, will occur much more often. The flow of the Danube will decrease by 5%, the flows of small rivers will decrease by 5–25%, especially during the summer. Following the negative scenario, sea level will rise by up to 0.5 meters. Part of the analyzed area (a part of Dobrogea) is threatened by desertification. Changes in temperature and average precipitation are accompanied by changes in extreme phenomena (increased frequency of droughts, floods, hail, etc.)



Flood in Apuseni, Photo source: ISU Alba.

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