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D 5.4. Policy Proposals for Improved Coherence to Encourage Adaptive Management of River Networks in EU and Member States

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Abstract

Rivers are biodiversity hotspots that are habitats to many species and provide multiple ecosystem services. They are pressured by drying, which causes a threat to rivers biodiversity. DRYvER project has focused on Drying River Networks (DRN) that act as ecological corridors for species and contribute to carbon cycle and provisioning of key ecosystem services in the European Union (EU) and in South America. With this policy report we list the policy measures aimed at securing biodiversity, water quality and ecosystem services and summarize results of stakeholder workshops from Spain, Hungary, France, Finland, Croatia and Czech Republic. We study horizontal policy coherence between EU policies that are relevant for the adaptive management of the DRNs. We provide policy recommendations for improved coherence and to encourage adaptive management within the DRN.

Key to targeting effective implementation of policies across Europa is the contextualization of the legislative EU frameworks. Currently, the implementation of policies relevant for the drying rivers and related networks is largely not aligned with the provisions of the EU legislation and it also differs remarkably across regions and Member States. Policy recommendation building on the experiences from local level is needed to further develop the regulation and guidance supporting the implementation of regulation.

The introductory Background section offers an overview of the status and pressures on intermittent ecosystems and explains some of the basic concepts that help us understand and sustainably manage these fragile ecosystems. Next, the policies and regulations related to the adaptive management of the DRN is described. We will present policy recommendations to the adaptive management of the DRN.

Keywords

Nature-based solutions, restoration, nature, dry, river, ecosystem, mitigation, adaptation, climate change

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[1] **Use one of the following codes:**
R=Document, report (excluding the periodic and final reports)
DEM=Demonstrator, pilot, prototype, plan designs
DEC=Websites, patents filing,press & media actions, videos, etc.
OTHER=Software, technical diagram, etc.
ORDP : Open Research Data Pilot

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Contents

Executive summary

River ecosystems are biodiversity hotspots; they provide essential ecosystem functions and services, including provision of drinking water, food, climate regulation among others that are vital for human health and wellbeing. Currently river ecosystems are undergoing unprecedented changes because of accelerating climate change. Intensive (seasonal) drying is one of the key threats. The consequences of drying on river biota and environmental conditions can be highly different in naturally drying rivers and anthropogenically drying rivers, because of the lack of adaptions of organisms in the latter. Anthropogenically drying rivers often combine many other stressors such as contamination by pollutants or hydromorphological alterations. The DRYvER project aims to collect, analyse and model data and conduct ecosystem services valuation and knowledge co-creation in Drying River Networks (DRNs), a concept developed by the project. The project has focused on six selected DRNs in the EU that act as ecological corridors for species and contribute to carbon cycle and provisioning of key ecosystem services in the and three in South America.

In this policy report, we assess the coherence of EU regulation and policies in terms of achieving adaptive management, and recommend policy proposals for improved management, of DRNs. We list the policy measures that target biodiversity, water quality and ecosystem services. This report evaluates horizontal coherence between EU policies relevant for the adaptive management of DRNs. Policy coherence refers to how well policies are aligned to promote synergies and reduce conflicts between their objectives. Horizontal coherence refers to coherence of multiple policies on the same governance level, e.g. are European policies coherent towards the objectives of each other or are implementation of the European level policies in member states coherent with each other. The important message of this policy report is on how the legislative EU frameworks are contextualized on a local scale.

Within DRYVER, we organized workshops based on Future-Forward thinking in each of the DRNs. In this policy report, we present results of the future forward-thinking workshops in six DRNs (Genal, Spain, Bükkösdi, Hungary, Albarine, France, Lepsämänjoki, Finland, Butižnica, Croatia and Velicka, Czech republic). In the workshops, held in 2022, 2023 and 2024, we implemented the IPBES Nature Future Framework to shed light on how to improve water governance across Europe in the near future. Each DRN had its own characteristics and

challenges with local implementation of the WFD and other EU legislation. Drying continues to be a challenge in many of the DRN sites, requiring adaptive management.

Based on the analyses of these workshops, we found that implementation is largely not aligned with the provisions of EU legislation and differs across the EU Member States and regions. Thus, local-level feedback is needed when EU policy makers aim to improve regulations or provide further guidance for implementation. This policy report supports these improvements from the perspective of adaptive management. The multidisciplinary team consisting of natural scientists and environmental social scientists have identified local management gaps with the local stakeholders. If this local understanding is better integrated to the current policies and their implementation, this could lead to improved EU policy development and better management of DRNs.

We give policy recommendations for the improvement of adaptive governance and management of DRNs. There is a need to enlarge monitoring to better cover small, non-perennial streams that are not considered as water bodies and therefore often excluded from national monitoring and assessments. Long-term ecological data and hydrological modelling can provide knowledge on DRNs, which is helpful for environmental management. Learning and experimentation is needed for the adaptive management of the DRNs.

For restoring rivers and their ecological functions, ensuring species dispersal is essential. Water loss can be limited through nature-based solutions such as establishing wetlands, and land use change to retain and recycle water, which should be supported by European policies such as Habitats Directive and Nature Restoration Law. DRNs should be protected and restored in accordance with the EU Biodiversity Strategy objectives and other relevant legislation, especially the Habitats Directive and Nature Restoration Law to safeguard multiple ecological functions provided by the river networks. Especially non-perennial segments should be considered as integral part of the river network. Climate change adaptation should be considered in restoration policy and other policy sectors. There is a need to overcome the operational challenges for biodiversity conservation in river networks and to establish pathways for river restoration, as well as their financial instruments enabling effective implementation of adaptation measures.

Acronyms

BD	Birds directive
CAP	Common Agricultural Policy
DRN	Drying River Network
EAGF	European Agricultural Guarantee Fund
EAFRD	Agricultural Fund for Rural Development
EBM	Ecosystem-based management
FCS	favourable conservation status
HD	Habitats Directive
NBS	Nature based solution
ND	Nitrates Directive
NRL	Nature restoration law
RBMP	River Basin Management Plan
WFD	Water Framework Directive
WP	Work package

I. INTRODUCTION

Background

Rivers are biodiversity hotspots and provide essential ecosystem services and functions, including provision of drinking water, food, climate regulation among others that are vital for human wellbeing (Datry et al., 2021; Reid et al., 2019; Cid et al., 2021). All river networks are composed of perennial and nonperennial river segments, the latter making up to 60% of the total river length on Earth (Datry et al., 2023b; Messager et al., 2021). Non-perennial river segments can be naturally intermittent due to climatic, geological or hydrogeologic causes, whereas more and more once-perennial rivers are drying due to human water uses, such as water abstraction, river damming or land use alterations. Ongoing climate change further increases the risks of drying and may lead to declines in species diversity and irreversible shifts in the composition of communities across river networks. Drying can cause dramatic ecological shifts in the riverine biodiversity and ecological integrity by influencing the spatial and temporal distribution of water, nutrients and organisms (Sarremejane et al., 2021). This necessitates adaptive management, which has the potential to incorporate uncertainty and learning into management decisions to safeguard biodiversity and ecosystem functions and services in the river networks (Pahl-Wostl, 2020).

The consequences of drying on river biota and environmental conditions can be highly different in natural and anthropogenically altered rivers, because of the lack of adaptions of organisms in the latter which also often combine many other stressors such as contamination or physical alterations (Datry et al., 2023a). However, non-perennial river segments are only rarely considered as their own river type in Water Framework Directive, where ecological status of a water body is assessed through comparison of biological quality elements with reference conditions, i.e., comparing the site with undisturbed, or minimally disturbed sites. Many DRNs are also relatively small and are not legally recognized as water bodies.

Drying, which is accelerated by climate change is enforcing habitat fragmentation, which is a threat to river biodiversity, and it weakens many ecosystem services provided by freshwaters, including cultural services such as recreation and fishing (Datry et al., 2023b). Accumulating

evidence indicates that network-scale biological responses to drying are strongly dependent on other fragmentation sources (e.g. damming) in the river network, especially that caused by dams and other human-made structures (Cid et al., 2021). River fragmentation alters river natural flow and can worsen the drying taking place during heatwaves. It also blocks migration of species, which is needed to avoid harmful impacts of DRNs and warming waters on aquatic species. Dry and hot periods are about to increase in many parts of Europe, because of the evident impacts of climate change. This calls to reconsider the free-flowing river framework developed at the EU scale by including fragmentation by drying.

Drying is making it increasingly hard to reach the EU Water Framework Directive (WFD) objectives. Problems with implementation, such as reaching the good ecological status objectives, institutional misfit, and inability to adjust to local contexts have been recorded by regional authorities and other water management actors. Neglecting the non-perennial segments in river management has often led to environmental problems such as impaired water quality, loss of biodiversity and alteration of natural flow regimes at the river-network scale. Sustaining and restoring ecological integrity of the entire river network requires integrated management strategies that explicitly consider non-perennial segments and their connections with perennial ones on European and local scale.

In this policy report we will assess the coherence of EU regulation and policies in terms of achieving adaptive management of DRN. We will present results of the future forward-thinking workshops implementing IPBES Nature Future Framework in six DRNs in Spain, Hungary, France, Finland, Croatia and Czech Republic. We will give policy recommendations for the adaptive governance and management of the DRN. To this end, we will first present our methodological approach and conceptual background in chapter 2. Subsequently, in chapter 3 we will present our coherence analysis, aiming at assessing horizontal coherence of the WFD, Nitrates Directive (ND), Habitats Directive (HD), Birds Directive (BD), Nature Restoration Law (NRL) and Common Agricultural Policy (CAP). In chapter 4 we will present the results of the workshops in DRN. In chapter 5 we will discuss the results and give policy recommendations.

II. THEORETICAL AND METHODOLOGICAL APPROACH

Policy coherence and integration

The environmental policy of the EU is enforced through directives and regulations, some of which are binding as such, while others need to be implemented into the national legislation of the member states. In a policy area, governance rests on a mix of policy instruments and is also influenced by instruments from other policy fields (Oberthür & Gehring, 2006). Enhancing synergies and coherence between policy instruments has been part of discussions on European governance since the early 2000's. EU's environmental policy consists of numerous policy instruments that have integrated various policy goals into their design (Ibid.). The Organization for Economic Cooperation and Development (OECD) has published guidance on policy coherence to achieve sustainable development as part of its better regulation initiatives (OECD, 2018).

Policy coherence refers to relationships between policies, which require coordination, collaboration and cooperation to support the achievement of shared objectives withing and across policies (Nilsson et al., 2012). It is a widely debated topic in European policy schemes due to the horizontal and vertical fragmentation of the EU and its member states' institutions and policies. Horizontal coherence refers to synergies and support for the achievement of shared (e.g., environmental) objectives across individual policies (Kurze & Lenschow, 2018), for example, energy and environmental policies or agricultural and biodiversity policies). Vertical coherence relates to the extent to which the resulting interplay between directives' national and local implementation assists in reaching key environmental objectives.

Traditional policy analysis has often focused on the effectiveness of policy implementation, whereas the policy mix approach has studied the consistency and efficiency of a given set of policy instruments within a policy sector or sectors (Kanger et al., 2020). It is important to note that a sectoral policy can be effective in achieving its own objectives without being coherent with other policy areas and their objectives. Policy coherence has been seen as significant for the successful implementation of policy frameworks, as coherent policymaking can navigate trade-offs and synergies between multiple policy goals and sectors (Antwi-Agyei, 2017; OECD 2018; Nilsson & Weitz, 2019; Shawoo et al., 2023). Coherence analysis can combine analysis

on policy outputs and integration and the implementation of policy instruments and objectives.

Policy integration refers to the process of incorporating overarching objectives, such as sustainable development or environmental objectives into sectoral policies and is linked to policy design (Nilsson et al., 2012). The policy instruments and processes are part of the policy design that aims to achieve policy goals.

Policy implementation refers to arrangements and interactions by authorities and other actors for the enforcement of policy instruments (Ibid.). Since EU directives are implemented at the national and regional levels, scholars of EU policy implementation have often focused on the concern of whether the actions of policy stakeholders that implement the policy conform to the policy (Treib, 2014; Zhelyazkova et al., 2021).

Policy evaluation covers all stages of the policy process from policy design to implementation and policy outcomes (Ibid.).

Adaptive management

Adaptive management has been promoted through the EU water policy for the past decades (Pahl-Wostl, 2020). The concept originates from socio-ecologic systems literature and it has been perceived essential to reach sustainability and as a requirement of natural resource governance (Pahl-Wostl, 2009; Pahl-Wostl, 2013; Hasselman, 2017). Adaptive management has been defined as a process of adaptive environmental management and policy design, which integrates environmental with economic and social understanding at the beginning of the process (Holling, 1978; Hasselman, 2017).

WFD introduces *ecosystem-based management,* which runs in a cyclical planning process with water management plans updated every six years (Kaika and Page, 2003; Jager et al., 2016; Kochskämper et al., 2016). There are multiple benefits of ecosystem-based management, such as addressing cumulative impacts, delivering ecosystem benefits and services and enhancing adaptive management. The ecosystem-based management approach can bring stakeholders and rights together for envisioning a desired future with measurable goals, building, or strengthening capacity, co-producing knowledge, co-innovating solutions, and practicing adaptive management.

Adaptive governance is about increasing the capacity of complex socio-ecologic systems to respond to changing circumstances, such as environmental change caused by climate change (Olsson et al., 2006). The approach takes scale and social-ecological complexity into account and motivates experimentation to reduce uncertainty (Chaffin et.al., 2014). Adaptive governance aims to find common solutions through collective learning and participation. Collective learning aims at co-creating the knowledge base and integrating scientific knowledge into decision making. Participation aims at democratic processes as one of the main deliverables of governance. It has the potential of contributing to the legitimacy and sustainability of policy making.

Several approaches and concepts have been outlined in adaptive governance literature to increase this capacity. Ecosystem based management (EBM), nature-based solutions (NBS) and learning has been suggested as a way forward to reducing the vulnerabilities of the governance system and to build adaptive capacity. The starting point for enhancing NBS is the claim that governance and management practices that aim at efficiency in delivering ecosystem goods and services lead to increased vulnerability of the managed water system to unexpected change (Olsson et al., 2006; Folke et.al., 2002; Gunderson & Holling, 2002). By enhancing NBS it is possible to increase the resilience of the given system.

Resilience is a concept that refers to the ability of a social-ecological system to absorb disturbance and reorganize while undergoing change (Holling, 1973; Folke, 2016). Within the adaptation to climate change literature resilience has been studied as getting accustomed to the inevitable. The concept origins from environmental sciences, wherein the resilience is about ecosystems or species capacity to cope with changing environmental circumstances and to keep the same function, structure, identity, and feedback.

III. ASSESSING THE POLICY COHERENCE IN THE EU LEVEL AND MEMBER STATES

The Water Framework Directive - setting the targets of good environmental status

Since its enactment in 2000, the Water Framework Directive (2000/60/EC; WFD, European Commission, 2000) regulates the ecological condition of rivers, lakes, transitional waters,

coastal waters and groundwater. The directive aims at achieving *good ecological and chemical status* of all European surface waters and groundwaters by 2015 or by 2027 the latest. For surface waters category – lakes, rivers, transitional waters and coastal waters – the good status objective covers good ecological status and good chemical status (Art 4(1), paragraph a). The surface waters of each category are further separated into types based on natural geographical characteristics. As defined in art. 2.4 "river" means a body of inland water flowing for the most part on the surface of the land but which may flow underground for part of its course. Further, art. 4.10 refers to "body of surface water", which is defined as "a discrete and significant element of surface water such as a lake, a reservoir, a stream, river or canal, part of a stream, river or canal, a transitional water or a stretch of coastal water." European countries have defined over 1000 national river types to implement the WFD (Lyche Solheim, 2019).

Ecological status aims to describe the structure and functioning of the surface water ecosystem as classified in accordance with Annex V of the directive. All pressures affecting aquatic ecosystems are accounted for, and the status of waters is monitored and assessed based on a classification of ecological status into high, good, moderate, poor, and bad (Heiskanen et al., 2004). The ecological status assessment is based on physico-chemical and hydro-morphological quality elements, which should be on certain levels to safeguard a functioning ecosystem. The status classification is based on Biological Quality Elements, which should show only a low level of distortion caused by human activity (WFD Annex V). The biological factors of coastal waters include phytoplankton, other aquatic vegetation and benthic fauna. Hydrological-morphological factors include the variation in depth, the structure and quality of the bottom on the coast, and the effect of waves. Physico-chemical factors include visibility depth, thermal conditions, oxygen conditions, salinity, nutrient conditions and special concentrations of pollutants. Flow intermittence causes challenges for ecological status assessments and intermittent streams are typically poorly represented in biomonitoring programmes, which were established to implement WFD ecological status assessments (Stubbington et al., 2018).

EU member states are required by the non-deterioration clause to implement all the necessary measures to prevent further deterioration of water bodies in their territory (WFD Article 4.1(a)(i); 4.1(b)(i)). This non-deterioration clause regulates all waters including those in

less than good status, good status, and excellent status. The good ecological status and non-deterioration requirements are both legally binding for the EU member states, confirmed by the Court of Justice of the European Union in the Weser-ruling (CJEU C-461/13). States must account for the WFD requirements when permitting new projects with impact on water quality (Soininen and Platjouw, 2018).

Under the Directive, member states must implement river basin management (Kaika & Page, 2003; Voulvoulis et al., 2017). According to art 2.13 "river basin" means the area of land from which all surface run-off flows through a sequence of streams, rivers and, possibly, lakes into the sea at a single river mouth, estuary or delta. The directive establishes adaptive management through a cyclical approach of 6-year planning cycles in River Basin Management Plans, which are drafted in a process with extensive public consultations. River basin management plans are complemented by Programmes of Measures for the implementation cycles of 2009–2015, 2016–2021 and 2022–2027. The European Commission monitors WFD implementation and published its 6th implementation report in 2021, concluding that agriculture is one of the main drivers for failure to achieve good status in EU water bodies (European Commission, 2021).

Nitrates Directive

Since its enactment in 1991, the Nitrates Directive (ND; 91/676/EEC, European Council, 1991) has been guiding water protection from nitrates contamination. Nitrates concentration results from nitrogen compounds from fertilizers, manure leaching into the groundwater, and runoff from agricultural land to the surface waters. The directive aims at promoting good farming practices and preventing nitrates pollution from agricultural sources. It regulates the monitoring of nitrate concentrations of water bodies, designating nitrate vulnerable zones, and establishing codes of good agricultural practices and measures to prevent and reduce water pollution from nitrates.

The goal of establishing Nitrate Vulnerable Zones is to focus water protection measures on waters where the concentration of nitrates exceeds 50 mg/l. The ND with its national implementation has decreased N leaching to the surface and ground waters and to the atmosphere (Velthof et al., 2014). In nitrate vulnerable zones, nitrate levels are exceeded because of failure in ground water management, rather than lack of knowledge or available

water protection techniques (Musacchio et al., 2020). In non-vulnerable zones, Member States can propose a set of voluntary measures, such as time periods and weather conditions for fertilizer use. Many of the measures are aligned with the WFD objectives. The ND is one of the Statutory Management Requirements of the Common Agricultural Policy (see below).

Habitats Directive

The Habitats Directive (HD; 92/43/EEC, European Council, 1992) was adopted in 1992. It aims to ensure that all species and habitat types are maintained or restored to a favourable conservation status (FCS) within the EU. Further decline of species and habitats should be halted and in the long run, the directive aims at their recovery and thriving. The directive targets the conservation of over a thousand species, including mammals, reptiles, amphibians, fish invertebrates and plants and 230 habitat types (European Commission, 2024c). The Habitats Directive's Annex I protects 32 river and lake habitat types as well as several alluvial and riparian habitat types. Some of the habitats types are connected to Dry River Network, such as intermittently flowing Mediterranean rivers (3290) and Mediterranean temporary ponds (3170). The HD species are listed in Annex IV of the directive and their protection must be ensured inside and outside of Natura 2000 sites.

The HD defines that the conservation level of a species is favourable when it is maintaining itself on a long-term basis as a viable component of its natural habitats, and its natural range is neither being reduced nor is likely to be reduced for the foreseeable future. In addition, there should be a sufficiently large habitat to maintain its populations on a long-term basis (Art 1(1), paragraph (i)).

In turn, the conservation level of habitats is favourable when its natural range and areas it covers within that range are stable or increasing, the specific structure and functions necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable (Art 1(1) paragraph (e)).

Birds' directive

Birds Directive (2009/147/EC, European Commission, 2009) on conservation of wild birds was adopted in 2009. With respect to the BD, the directive's most important substantive obligation

is laid down in Article 2, according to which "Member States must take all necessary measures to maintain the populations of the bird species at a level that meets especially ecological, scientific and cultural requirements, taking into account economic and recreational requirements, or to adapt these strains to this level." Although the BD does not explicitly use the concept of a favourable conservation status, its objectives are generally associated to mean striving for a favourable conservation status for all wild birds. Variability in river flow and weather extremes impact habitats of river birds, especially those dependent on aquatic invertebrates (Royan et al., 2014).

Nature Restoration Law

Nature Restoration Law (2024/1991/EU, European Commission, 2024d) is a comprehensive piece of legislation aiming at restorations of ecosystems for people, climate and the planet. The function of the NRL is to provide explicit, directly legally binding obligations on Member States on putting in place and implementing restoration measures to improve the quality of these ecosystems and habitats, which supports and enforces the obligations on reaching the favourable conservation status (FCS) of the Nature Directives.

The proposed NRL includes obligations related to protecting and restoring river habitat types and habitats of riverine species (Stoffers et al., 2024). The NRL puts forward a general obligation for Member States to put in place effective and area-based restoration measures with the aim to jointly cover, as a Union target, at least 20 % of land areas and at least 20 % of sea areas by 2030, and all ecosystems in need of restoration by 2050 (Art 1(2)). In addition to this EU-wide objective, Articles 4-13 include more specific restoration targets and obligations for the Member States individually, wherein Article 4 addresses terrestrial, coastal and freshwater habitats.

The NRL aims to:

(1) establish restoration actions for habitat types listed in HD Annex I that require restoration actions to achieve good status (Article 4.1)

(2) re-establish habitat types listed in Annex I HD where these were lost (Article 4.2)

(3) re-establish habitats of the species listed in Annexes II, IV, and V of the HD and wild birds of the BD (Article 4.3)

To fullfil the directives aims, the most suitable restoration areas will be determined using best available knowledge and recent scientific evidence of the condition of the habitat types listed in HD Annex I. The condition is measured by habitats structure, functions, and presence of typical species, all of which are requirements for good long-term ecological functioning (Article 4.4). Restoration measures must consider the need for improved connectivity among the habitat types listed in HD Annex I and the ecological requirements of typical species (Article 4.5). The NRL states that areas where good condition and adequate quality of species' habitats have been achieved should not deteriorate (Article 4.6).

Article 7 of the NRL specifically addresses restoration targets for river ecosystems. One of the NRL's key objectives is the restoration of natural connectivity and functions of running water ecosystems, with the aim to achieve at least an additional 25,000 km of free-flowing rivers in Europe by 2030. There are two types of connectivity: longitudinal connectivity means that river is connected along its length and lateral connectivity means that river is connected to the wetlands and floodplains on either side of the river. To accomplish the restoration objective, Member States are asked to develop an inventory of artificial barriers of surface-water connectivity, and identify the barriers that must be removed to contribute to the restoration target, considering their socio-economic functions (Article 7.1). Next, the Member States should remove the identified obsolete barriers in order to restore river connectivity and prioritize the removal of barriers that are no longer required for renewable energy production, inland navigation, water supply, flood protection, or other purposes (Article 7.2). They should also implement measures that enhance the natural functions of related floodplains (Article 7.3). Member States must also ensure that the natural connectivity of rivers and the natural functions of the associated floodplains are maintained (Article 7.4).

Additionally, Member States are expected to prepare national restoration plans until 2050 and to conduct preliminary monitoring and research to identify the necessary restoration measures to restore habitats and increase biodiversity (Article 11). The restoration plans should identify the areas to be restored within and outside the Natura 2000 network (Article 12.2a, b). The Member States should create an inventory of artificial barriers to be removed

and establish measures to restore the natural functions of floodplains (Article 12.2e). In the national plans, they should include monitoring of restoration areas as well as evaluation of the ecological efficacy of restoration measures, ensure long-term effects, consider climate change scenarios, collaborate with national energy and climate plans, and estimate financing needs (Articles 12.2h-l). The plans should consider the quality and quantity of specific habitats needed for species protection, such as nursery and spawning areas and the connectivity between essential habitats for species to complete their life cycles (Stoffers et al., 2024).

EU Common Agricultural Policy

The Common Agricultural Policy (CAP) is the main instrument for promoting agriculture and its financing in the EU (European Commission, 2024a). The overall policy is formulated in Regulation (EU) 2021/2115 establishing rules on support for strategic plans to be drawn up by Member States under the CAP and the policy is financed through the European Agricultural Guarantee Fund (EAGF) and by the European Agricultural Fund for Rural Development (EAFRD).

The policy has three general objectives as prescribed in article 5:

a) to foster a smart, competitive, resilient and diversified agricultural sector ensuring long-term food security.

b) to support and strengthen environmental protection, including biodiversity, and climate action and to contribute to achieving the environmental and climate-related objectives of the Union, including its commitments under the Paris Agreement.

c) to strengthen the socio-economic fabric of rural areas. As the policy is not mainly environmentally focused, the policy includes objectives concerning other subjects than the environment and objectives that the achievement of will or might result in degradation of the environment.

The objectives of CAP are further defined in ten specific objectives, as formulated in article 6d-f of the regulation, of which three directly concern the environment and climate.

• to contribute to climate change mitigation and adaptation, including by reducing greenhouse gas emissions and enhancing carbon sequestration, as well as to promote sustainable energy.

• to foster sustainable development and efficient management of natural resources such as water, soil and air, including by reducing chemical dependency.

• to contribute to halting and reversing biodiversity loss, enhance ecosystem services and preserve habitats and landscapes.

The CAP has a significant impact on water protection in agriculture among the other objectives, based on its environmental payment scheme. Until the 1992 CAP reform, the agricultural policy was supporting the mechanisation and intensification of agriculture (García-Feced et al., 2014), and in the reform, environmentally sustainable farmland management objectives were introduced. Environmental objectives have been added to the payment scheme, by each CAP reform introducing new measures. Those objectives are related to reduced pollution, biodiversity, climate change mitigation and adaptation, and sustainable natural resource management.

In the CAP programmatic period 2021–2027, each member state must develop a national strategic plan defining the measures and the requirements of their national agricultural policy. These plans will be approved by the EU. The new model of CAP increases member states' roles in forming the policy and decreases the role of "one size fits all" policy. The new programmatic period aims to increasingly promote environmental and climate measures, while the total CAP funding from the EU will be reduced. The subsidies are nationally described in CAP strategic plan for 2023–2027, in each member state. Under the CAP reform, water protection measures are included in the eco-scheme and environmental payment system. The CAP and the national strategic plans set environmental standards that the farmer must fulfil to receive subsidies. This conditionality of financial support on compliance with environmental rules is called the cross-compliance mechanism (European Commission, 2024b).

The CAP is divided into two pillars of direct support and rural development (Aznar et al., 2023). Pillar I (75% of the funding) includes decoupled support payments as well as production related support, funded from the EU's budget. Pillar I direct payments are directed

to production-related renewal of agriculture and they include basic payment, support for greening, young farmer support, and production-related subsidies to certain sectors of products. For the programmatic period 2023–2027, eco-schemes under Pillar I were introduced with measures providing environmental and climate benefits (Runge et al., 2022). To be eligible for Pillar I payments, farmers must follow cross-compliance conditions, legal requirements, and the conditions for greening.

Pillar II (25% of the funding) subsidies are directed to less-favourable areas, agri-environmental schemes, organic farming, and animal welfare. The agri-environmental scheme aims to protect biodiversity, water, and soils. Pillar II subsidies are funded by the EU's rural development funds and national funds. Pillar II is voluntary for the farmers but mandatory for the member states. To receive subsidies for practices that limit the nitrogen and phosphorus emission, farmers can join the agri-environmental-climate scheme. It includes measures such as buffer zones, catch crops and plant cover on arable land on winter. Subsidies are area-based with an upper limit. There is also a support system for non-productive investments, such as establishing wetlands to reduce nutrient emissions and to promote biodiversity. (Uthes & Matzdorf, 2013).

Agri-environmental schemes under Pillar II are based on voluntary contracts between farmers and public authorities, usually signed for five years (Aznar et al., 2023). Farmers must comply with these requirements to receive Pillar I and Pillar II subsidies, except farms implementing organic farming (Alarcón-Segura et al., 2023). The member states decide which measures to include under eco-schemes and agri-environmental schemes (Runge et al., 2022). The agri-environmental scheme of the CAP has been criticized for its lack of effectiveness in terms of environmental outcomes (Rega & Spaziente, 2013). Aznar et al., (2023) see that the agri-environmental scheme could open a discussion on the new role of farmers as providers of multiple ecosystem services. As a related issue, the monitoring and evaluation frameworks of the CAP have been considered ineffective. Reducing administrative burden and increasing participation has been called for (El Benni et al., 2022). CAP language remains overly technical, and the national CAP strategic plans of the member states and their implementation are undeniably bureaucratic.

Horizontal coherence of the WFD and EU biodiversity policies

The WFD good environmental status objective is also relevant for overall biodiversity. The WFD applies to inland, transitional and coastal waters and groundwaters. The WFD's good ecological status objective describes the general state of the water body, where the structure and functioning of the surface water ecosystem is good. Some of the quality elements used in this assessment are linked to biodiversity factors. The WFD's good status objective also includes the composition and abundance ratios of aquatic vegetation and benthic fauna. Furthermore, good status generally supports the species and habitat types present in the water body, especially as it can address pressures such as chemical pollution and eutrophication.

Moreover, Article 6(1) of the WFD obliges Member States to maintain a register of all surface waters designated as specially protected in EU nature protection legislation. These areas include especially the Natura 2000 areas. According to Art 4(1) paragraph (c) of the WFD, Member States must achieve the compliance with any conservation objectives for these protected areas by 2015, unless the legislation underlying the protection stipulates otherwise. According to the Commission, this means that Member States must recognize the elements of surface waters that are necessary for achieving and maintaining a favourable conservation status of the relevant habitat and species and pay particular attention to those in water management (European Commission, 2011).

While biodiversity is not explicitly included in the WFD's objectives, the Directive's requirements should be interpreted and implemented in view of supporting the conservation aspects deriving from other directives, mainly the Nature Directives. However, potential conflicts may arise between the conservation of the species and the WFD's objectives, particularly if the species is dependent on changed conditions in the water body that do not correspond to good status; such situations may arise for instance in relation to bird habitats (European Commission, 2011).

Horizontal coherence of NRL and biodiversity policies

The function of the NRL is to provide explicit, directly legally binding obligations on Member States on putting in place and implementing restoration measures to improve the quality of these ecosystems and habitats. The NRL supports and enforces the obligations on reaching the favourable conservation status (FCS) in the Nature Directives. The HD, the BD and the WFD have established biodiversity targets at the EU level (Stoffers, 2024). Regarding the scope of the NRL, the regulation is highly complementary to the nature directives. Article 4 imposes restoration obligations in relation to habitat types listed in Annex I of the regulation, which includes the habitat types listen in Annex I of the HD but lists also different habitats than HD. NRL lists also Mediterranean temporary ponds and intermittently flowing Mediterranean rivers, which are DRN habitats. In turn, Article 5 provides restoration obligations for ecosystems listed in Annex II of the regulation; this listing of ecosystems is based on a so-called EUNIS-classification, which is wider and more comprehensive than the HD's habitats. Furthermore, the NRL puts forward an obligation for Member States to ensure an increasing trend towards the sufficient quality and quantity of the habitats in the BD, and the HD.

The NRL's objectives are aiming to improve areas of habitats in good condition. The NRL requires Member States to put in place the restoration measures needed to improve to good condition areas of the habitats so that these measures cover 30 % of total area of all habitat types listed in Annex I that is not in good condition by 2030 (Art 4(1)(a)). Furthermore, by 2040 the restoration measures should cover 60 % of the area of each group of habitats not in good conditions and 90 % by 2050 (Art 4(1)(b)). Yet, a derogation is provided for 'very common and widespread groups of habitat types' (Art 4(2)). Furthermore, by 2040, restoration measures should cover 60 % of habitats, and, by 2050, on at least 90 % of the area of each of the groups 1 to 6 of the habitat types listed in Annex II that is not in good condition (Art 5(1)(b)). The restoration targets for 2030 concern total area of groups of habitats, not each habitat, meaning that Member States have flexibility to allocate the restoration efforts within the group. Furthermore, the ambition level for coverage of restoration for soft sediments is almost entirely up to Member States' discretion. Accordingly, the restoration targets do not fully match the obligations under the HD whose protection objectives and obligations concern each habitat individually.

With regard to restoration objectives, the NRL aims to explicitly foster synergies with the HD in particular. In relation to the HD habitats, the NRL stipulates that when putting in place the

restoration measures, priority is given to Natura 2000-areas. This generally supports the HD's regime where the conservation efforts are mainly targeted at the occurrence of habitats within the Natura 2000 network. The NRL also puts forward a new obligation to prevent deterioration of the HD habitats, which includes both habitats within Natura 2000-areas and the occurrences of the habitats outside of Natura 2000 -areas.

Furthermore, specific restoration obligations are provided for the habitats of species included in the Nature Directives conservation regimes and the NRL's Annex III (Art 4(7) and 5(5)). In addition to the objectives related to restoration of habitats towards good condition, the NRL also includes a second type of restoration objective, that is, re-establishment of habitats. The re-establishment of habitats aims at ensuring that they meet favourable reference area (Art 3(8)). This objective entails considering the area of the habitat that has been lost and reintroducing the habitat in those areas until the objective of favourable reference area is met.

For the HD habitats, Member States are to put in place restoration measures to re-establish the habitats in areas where they do not occur so that by 2030, the measures represent at least 30 % of the additional surface needed to reach the total favourable reference area for each group of habitat types. By 2040, measures should represent at least 60 % of that surface and by 2050, 100 % (Art 4(4)). Yet, a derogation enabling lowering the target area by 2050 is provided (Art 4(5)). Here again, it should be noted that the re-establishment objective does not concern each habitat type individually but constitutes a joint objective for the groups of habitats; as such, the objective is not fully in line with the HD and entails leeway for the Member States in the allocation of restoration efforts within the groups. The HD could provide an alternative to include small streams in a legal framework, but complementary monitoring and assessment within this framework are still extremely rare.

The coherence of CAP legal instruments and WFD

The CAP is an extensive policy scheme of the EU, and at its core, it supports agricultural production, ensures food security, and promotes rural development. The CAP includes an objective to foster sustainable development and efficient management of natural resources, such as water. The policy instruments in CAP introduces economic incentives for farmers to adhere to minimum environmental standards and even go beyond those by supporting

innovative and ambitious management. Given that water abstraction is amplifying drying in river networks, CAP can enhance more efficient use of water resources in agriculture through its support for rural development funds and cross-compliance mechanism (Heinz, 2008). For water pollution, CAP is potentially a very effective legal instrument to target the diffuse nutrient pollution into riverine waters where the WFD is unable to provide sufficient protection. The increased allocation of funding to environmental and climate commitments further increases the CAP's potential to support the pollution objectives rather than work against them. The application of the funding also bears several connections to the WFD, and funding can be allocated both to introduce commitments to help comply to the WFD requirements and to aid farmers in the transition.

There are several factors that will undermine or jeopardize the policy's coherence with the WFD. The first and foremost is that funds are not only allocated for activities that are aimed at protection, nor is its objective to do so. A significant portion of the funds are aimed at maintaining or expanding activities. Run-off and leaching of nutrients from fertilisation practices in agriculture is one of the main pressures on water quality and with large production comes increased pressure. The legal instruments of CAP are not ecosystem based insofar as funding for agricultural activities does not consider the status of the recipient water body.

The effectiveness of CAP as a legal instrument to aid the achievement of good status for all water bodies is dependent on efficient and effective national implementation, and CAPs ability to deliver effective results in water protection has been questioned. There is considerable leeway for Member States in the CAP implementation for determining the content of the national CAP Strategic Plans, selecting measures and allocating funds. A notable difference is seen in the national Strategic Plans and the content of the agricultural policy and measures implemented will greatly vary between the Member States. Further, the eco-schemes are mandatory for the Member States, but optional for farmers. As a legal instrument, it lacks legal bindingness for the farmers and the effectiveness will also be dependent on its ability to affect key activities.

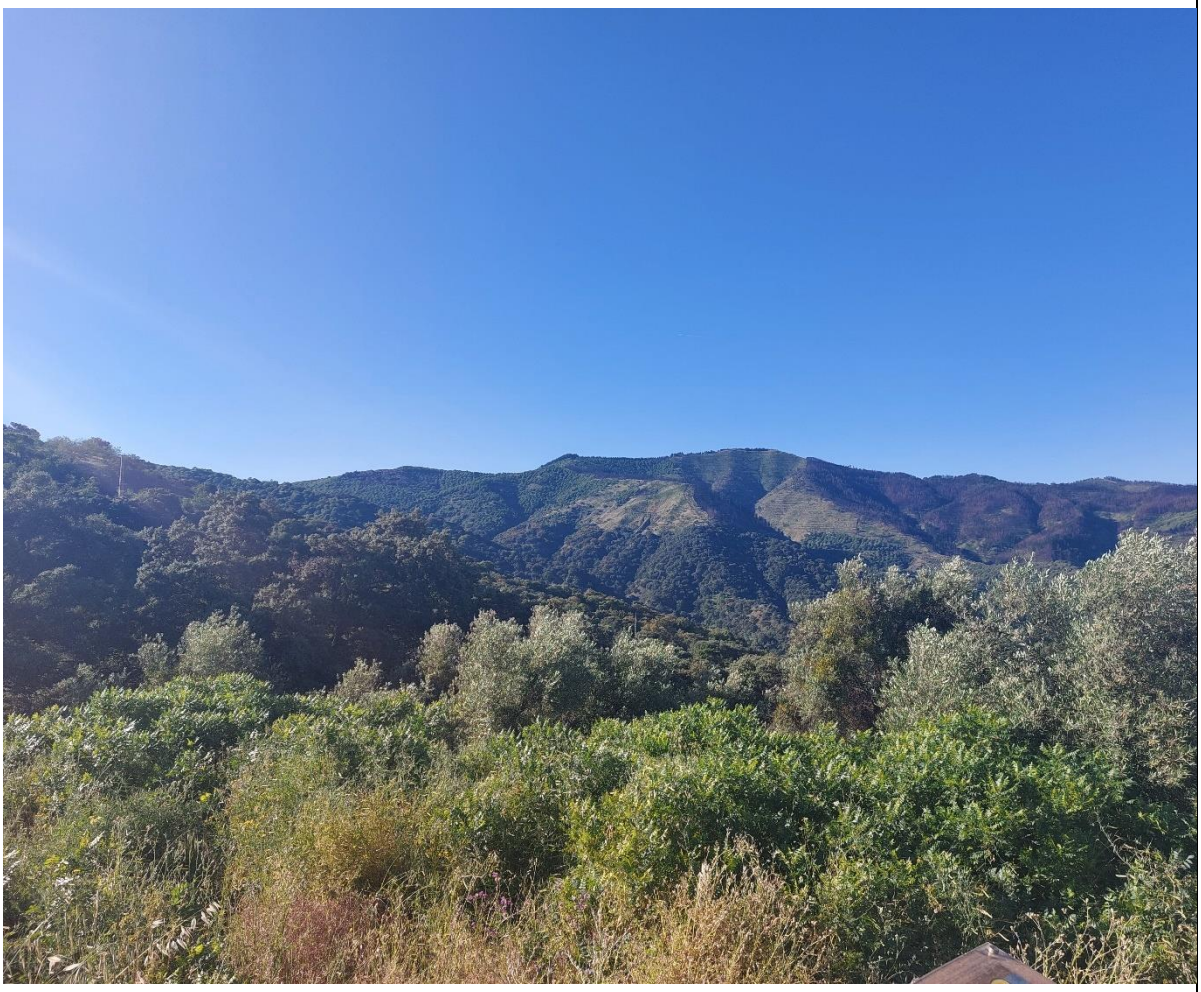
A significant number of payments under rural development are not tied to cross-compliance and as a result, a farmer who pollutes will continue to receive these payments without any reduction (European Court of Auditors, 2014). The tactic of paying polluters extra for

compliance with environmental standards has in earlier audits been noted as a step away from the polluter pays principle. In summary, the legal instruments of CAP include economic incentives towards reducing nutrient pollution that goes further than the bare minimum measures of the WFD and other environmental directives while also including legal instruments that will maintain or increase the pressure from the sector. The coherence of CAP with the WFD and other environmental directives will be highly dependent on the national strategic plans and follow-through.

Agricultural activities are also regulated in the WFD. The pollution from agriculture is the most significant source of diffuse pollution, causing one of the main pressures on surface water bodies. Simultaneously, the evaluations of the first and second round of RBMPs has pointed out that sources of nutrients from agricultural sources is a persisting problem, especially in regions with intensive agricultural activities (Wiering et. al. 2020). The WFD requires the identification of significant pressures, including diffuse pollution sources. In this context, by 'significant' is meant that the pressure leads to an impact that may cause failure to meet the requirements of the environmental objectives. A water body, if not in good status, will be target of programme of measures, which introduces the measures to tackle the external pressures. There is a wide range of measures that are taken. For agriculture encouraging environmental measures in agriculture to reduce nutrient pollution is significant. As noted above, CAP enables Member States to compensate farmers in full or partly area-specific disadvantages resulting from certain mandatory requirements.

IV. LESSONS LEARNED FROM THE DRN CASE STUDIES

Spain



Name of the DRN
Genal, Spain
When was the workshop organized?
27-29 May, 2022
What is the name and the size of the river basin?
The Spanish case study area is located in the mountains of Andalusia in southern Spain. It springs near the village of Igualeja in the south of the Serranía de Ronda in the northwest

of the province of Málaga and flows into the Guadiaro river near the border with the province of Cádiz. The Catchment Area includes the following sections: • Alto Genal • Bajo Genal
What are the main ecosystem services and land use in the area?
Fishing, agriculture and tourism
Describe the hydromorphology and other characteristics of the DRN
The Genal river basin area in general presents a good conservation status of the WFD, with all water bodies in either good or high ecological status, though smaller changes have taken place between the planning cycles. Regarding the hydromorphological quality elements, only the morphology has been assessed. The available information allows to identify non-significant pressures such as diffuse and point source pollution and water abstraction, caused by agriculture in lowland reaches and scattered urban uses, resulting in the drying of the riverbed in lowland areas. In addition, the river channel is commonly modified in the middle and lowland reaches to allow the retention of water for swimming.
What are the main anthropogenic stressors and challenges for water management in the DRN?
Regarding the measures, it remains largely unclear if these have been implemented in the past. Some of the planning documents refer to pressure-targeted measures such as wastewater treatment or the reduction of fertilizers and plant protection products in agriculture in the lowlands; whilst others target impacts (recovery of fish, invertebrates, amphibians, and reptiles). The river basin is subject to a planned water transfer tunnel as indicated in the second cycle of the River Basin Management Plan Water abstraction causes pressure in the river basin. Climate change is an exacerbating factor of increased frequency and impact of droughts and intense rainfalls, which can result in soil erosion and saline discharges. However, it is at present not considered in the planning. Wildfires are also a common problem in the river basin, which also have consequences for freshwater biodiversity, ecological functions and services.

Summarize the results of the discussion on past and the present?
Though the management plans are considered by the DRYvER case study lead as appropriate, including the systematic monitoring, identification of drivers, ability to adapt and including an appropriate set of measures, a concern was raised about the lack of measures to deal with drying adequately, especially bearing in mind the significant water abstraction pressures in the lower Genal river and its coastal area, and the sensitivity of biological quality elements, in particular fish, which is in decline. Furthermore, though the urban wastewater treatment plants have been included as a measure already in the first cycle RBMP, they have not yet been implemented, thus further allowing the deterioration of water quality locally.
Summarize the results of the discussion on the future?
In the Spanish case study, the poor implementation of the River Basin Management Plans' measures is a major barrier to its adequate management and conservation. Such poor implementation might be caused primarily by the lack of funding for solutions and administrative resources, derived from the lack of awareness and by water being not a priority. In addition, the lack of implementation of laws, legal rights and licenses and of data and knowledge is possibly causing constraints in the adaptation to drought and the conservation of river biodiversity during drought and water scarcity events.
What were the suggestions for environmental management in the DRN?
The following measures are documented in the Natura 2000 Management Plan: • Recovering fish and invertebrates • Recovery of amphibian & reptiles The measures of the Natura 2000 Management Plan can only be implemented if water management overall is improved and pressured reduced. Furthermore, it is questionable whether a recovery of the fish stock or invertebrates is necessary when the BQEs were defined as "high" in the second cycle RBMP. In the last 10-15 years, there has been a reduction in species and population sizes, mainly due to the increase of drying riverbed, according to expert knowledge.

Many potential measures to improve the water body status are listed in the CAP Rural Development Plan as well as in all three RBMPs. The CAP documents of course set general measures for the improvement of agriculture, for example through:

- Nutrient management plan
- Reduced inputs
- Training of farmers
- Conservation of biodiversity
- Organic farming: Extensive System/sustainable management

The status of the HyMoQEs improved to "good" in the classification of the second cycle RBMP. However, the measures to improve the ecosystem have remained the same in all three RBMPs and are the following:

- Sanitation and treatment of the wastewater of the municipalities in the upper & lower Genal basin
- Hydromorphological restoration
- Control of invasive species (for fish and riparian vegetation)

Only in the second cycle of the RBMP, the measure “Genal transfer tunnel” is specified. In the second cycle of the RBMP there is a time delay for the wastewater treatment of the municipalities for the upper & lower Genal basin due to disproportionate costs (WFD Art.4(4)). However, all quality elements have already reached a "good" status.

Hungary

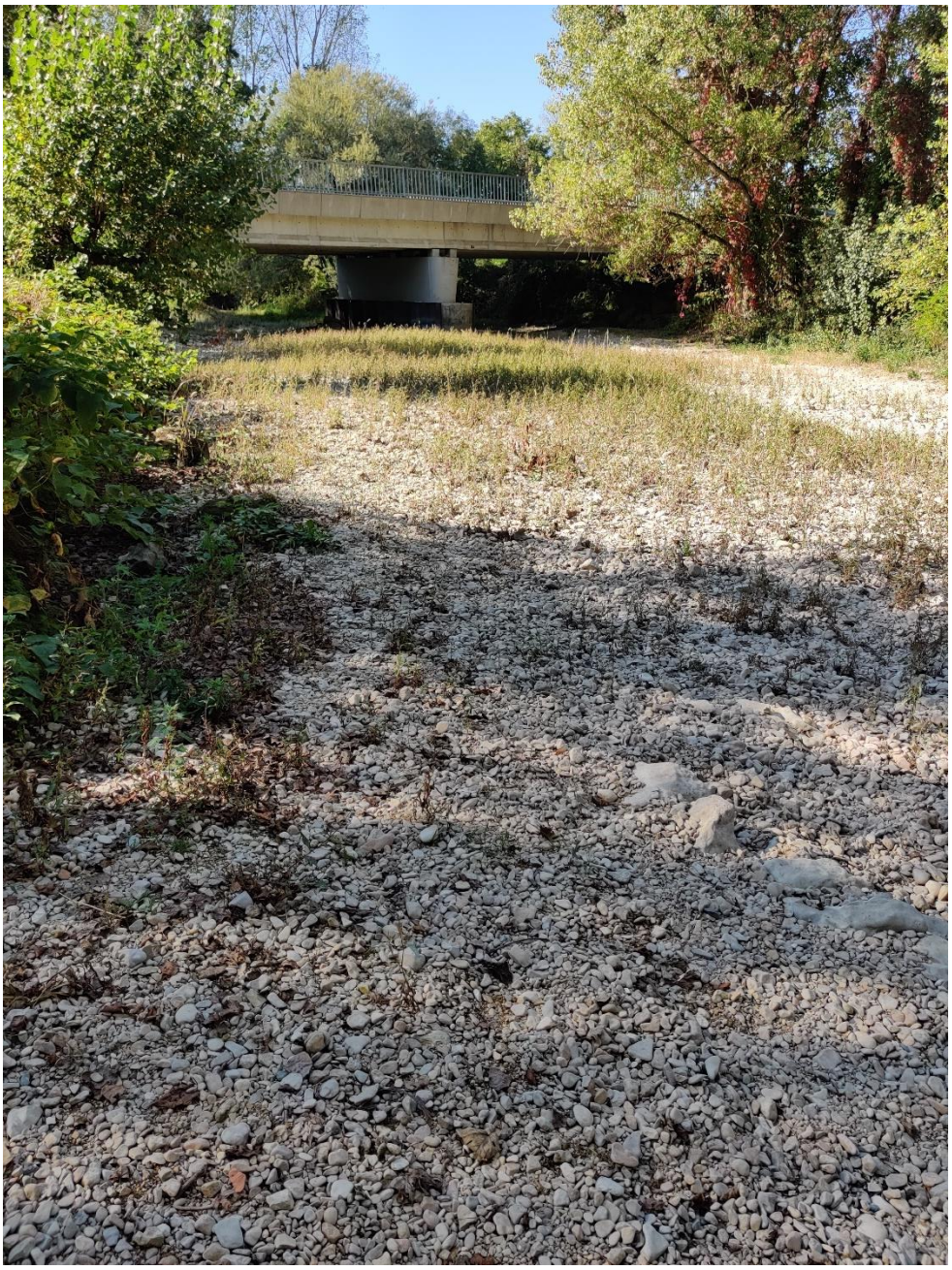
Name of the DRN
Bükkösdi, Hungary
When was the workshop organized?
17-20 May 2023
What is the name and the size of the river basin?
Bükkösdi-víz (apx. 185 km2) is part of the Fekete-víz cathment (apx. 1800 km2)
What are the main ecosystem services and land use in the area?
Agriculture, livestock, irrigation, forestry, tourism and fishing/angling

Describe the hydromorphology and other characteristics of the DRN
There are existing streamflow gauging stations within two catchments: 16 stations in Fekete-víz and 8 stations on Bükkösdi-víz. The Hungarian DRN has been affected by global change and drying only in the recent years. Before the DRYvER project started in 2020, the Bükkösdi-víz DRN (sometimes only some parts of it) was extensively monitored by UP. Before 2020 only 8-10% of the sections were characterized as intermittent. However, in 2021-2022 more than 50% of the sections ceased to flow or dried up. In the recent years (2023-2024) this percentage increased over 70-80%. Temporal extent of drying varies from few days to 100+ days; type varies from pools to completely dry streambed. The main stem of the catchment is heavily modified (channelized) in most parts, while the lower order stream sections are mostly in near natural or natural conditions. There are also several sampling sites which are overlapping with Natura 2000 sites. "Natura 200 species" (which are listed in the Habitats Directive) and Red List species (listed by the IUCN Red List of Threatened Species, except the Least Concerned category) which occured at the sampling sites are: *Astacus astacus*, *Gomphus simillimus*, *Unio crassus, Cordulegaster heros, Romanogobio uranoscopus, Leucaspius delineatus, Alburnoides bipunctatus*. (Several other macroinvertebrate species are protected locally which are not listed in the Habitats Directive). There is more forest in the upper part and more agricultural land in the lower part, where trees are cut close to the waterways for better access to water.
What are the main anthropogenic stressors and challenges for water management in the DRN?
Anthropogenic stressors derive from point and diffuse pollution sources. Point source originates from the municipalities and stone quarry near Hetvehely. Diffuse pollution originates from agriculture. Agricultural diffuse pollution is hard to tackle because landownership of the agricultural land belongs to multinationals. The main stem of the catchment is also heavily modified (channelized) in most parts. There are altogether

approximately 20-22 man-made structures (e.g. weirs, fishponds, etc.) in the catchment, but from these maybe 6-8 are substantial.
Summarize the results of the discussion on past and the present?
The stakeholders who participated in the workshop were saying that floods and droughts (generally extremities) are getting more frequent and severe. Floods occur annually and droughts are getting more extreme. According to a risk assessment by geographers, flood risk can be immanent in any Hungarian mountainous area. Drought events occur every year and in 2012 was a severe year and then from 2018 onwards getting worse. Hikers sense a decline in number of animals they meet during a drought compared to during rainy periods. Stakeholders mentioned recent problems (compared to the past) such as increase in extremities, uneven precipitation distribution, sedimentation of the streambed, decrease in the level of the groundwater, drying of wells, and changes in cultivation methods and water resource management. Changes in forest management increase the problem and therefore forest management and water management have a conflict of interest in the area. Regarding the increased floods surface run-off is a challenge. During droughts forest fires might occur. The stakeholders were emphasizing the increased dialogue and stakeholder co-operation is beneficial as water management is fragmented. The National Park would prefer nature like solutions and activities. Fishermen were stating that drying is a threat to fishing and fish populations. Fishing ponds are owned and managed by local fishermen and fishing associations.
Summarize the results of the discussion on the future?
The stakeholders wanted a future without flash floods. They would prefer to see controllability, permanence, and stability regarding waters which are close to/flowing through municipalities. They were mentioning that there is NBS in place - tiny ponds against drying – which they would like to see more in the future. They were saying that environmental managers should have more control over the water and improved flood protection. The regional authorities should be involved in planning and management of

the waters and in flood protection. Legislation should be in place that is enhancing the flood risk protection and water management. NBS could be introduced to keep water in the ecosystem. By planting more vegetation and trees, the water system could retain more water and act as a sponge. Forest cover could also function as a way to keep water in the landscape. Such sponge functions could be developed also in cities as NBS. This could create greener cities. More money should be allocated to the water management. Stakeholders were mentioning droughts. They said that national authorities and politicians are aware of the problem and recognize the need to develop new methods (NBS) to deal with the problem. They are building an action plan on droughts, which is not yet visible to local stakeholders. The NBS should be integrated into the action plan. One stakeholder was mentioning that the droughts are affecting the occurrence of wild animals. Local stakeholders and also local public should be educated on the problem. Young generation has the potential for change.
What were the suggestions for environmental management in the DRN?
Centralized governance and experts are creating the background for the environmental management. The stakeholders participating in the workshop were relying on scientific expertise and expert knowledge. They were saying that long term monitoring is needed and that the water authority is lacking ecological knowledge in their actions. Using NBS should be rewarding. This could be achieved through using a “carrot” instead of “stick”. Government should support farmers to implement NBS. Young people should be educated about nature. This should be done in schools and during afternoon activities of school children.

France



Name of the DRN
Albarine, France
When was the workshop organized?
10-12 October 2024

What is the name and the size of the river basin?
Albarine, 354 Km^2
What are the main ecosystem services and land use in the area?
The water is used as a source for urban and drinking water, agricultural irrigation, hydropower and the tourism sector. Further activities such as fishing, swimming, canoeing, and have been mentioned by stakeholders.
Describe the hydromorphology and other charasteristics of the DRN
The French case study is consisting of 3 river sections and one tributary. The Albarine river springs in the north of Brénod, which is a small commune in the Auvergne-Rhône-Alpes region in the Ain department in Eastern France with 500 inhabitants and flows into the river Ain at Saint-Maurice-de-Rémens. In the process, the Albarine flows through several villages and towns. The Catchment Area includes the following sections: · Ruisseau le Seymard · L'Albarine de sa source au bief du Vuires · L'Albarine du bief des Vuires à Torcieu · L'Albarine de Torcieu à l'Ain
What are the main anthropogenic stressors and challenges for water management in the DRN?
The French case planning documents refer to pollution through nutrients, pesticides, phosphorus and toxic substances originating from agriculture and urban wastewater. There is possible biodiversity loss and a poor status of benthic invertebrates in the upper part of the river. Measures to be implemented in the planning documents are the limitation of fertiliser application and the implementation of a better wastewater treatment. In the set of interviews, conducted in the catchment with 7 stakeholders, the French stakeholders

refer furthermore to climate change as a driver for the increased irrigation, inducing groundwater abstraction, water storage on the case study area.

Summarize the results of the discussion on past and the present?

In the Albarine workshop, main topics discussed were biodiversity, drinkable water and need to raise awareness on drying river networks.

The stakeholders mention that biodiversity is threatened and that there is a need to preserve what is left. Their perception of biodiversity includes fish, macroinvertebrates and the associated terrestrial fauna. They highlight the endemic mountain fauna and it's "genetic purity" as in Albarine, the trout is naturally breeding. They also mention genetic diversity.

The stakeholders explain that it is nice to promote the increase of the population in the valley but one must consider that it may not be possible due to the limited availability of drinking water. Nature will always adapt to change (some species will disappear and new ones will appear) but this will not be the case for the amount of available water. They discuss about drinking water, which is used for watering the garden or washing the car. There is no need to use drinking water for all those purposes.

One of the stakeholders, a fisherman explains that there is sometimes a lot of waste in the river area, and that they feel the need of collecting it when it is there. They say that it's a right to profit and enjoy the nature, but this has to be done with respect, and this though seems not to be in everyone's mind. There is still a big problem of education and there are differences between the different collectives. The stakeholders all agree that it is necessary to raise awareness among local people, because without raising awareness, one may not be really conscious about what you have and you don't valuate it enough. They continue that human thinks they own nature, and it might be true that humans have rights, but the notion of "owner" is the problem. They state that there is a difference in between working BY nature and working FOR nature ("travailler PAR ou travailler POUR la nature"). We are not WITH the nature but NEXT to the nature (on n'est pas AVEC la nature, on est À CÔTE). The current economic system overtakes us and it's turning against

us. They explain that we have to start from local actions, but always keeping in mind the global scale. Thus, global vision for local actions.
Summarize the results of the discussion on the future?
There is a consensus among the stakeholders about the need for local governance of the territory, in which the different institutions should discuss together about the Albarine. The Albarine could be seen as an idyllic scenario, an image of "co-living" with humans and protecting the nature. They talk about the need of thinking global and acting local. They mention bad examples where the state government has destroyed local initiatives. There could be local discussions with state representatives. The stakeholders also put forward a bad example of a local initiative taking place in Hauteville (village of the valley, on the plateau). With the proposal of building an aquatic wellness centre, they needed to reach the water table, which had risks and harmful consequences, and finally the project was not successful. The stakeholders complained about the waste of a huge amount of public money, which could have been used for better, well-developed initiatives. They argue that in a lot of cases, the opinion of the locals is not heard, and residents of small villages feel ignored. In the discussion the term of local governance appears again. Furthermore, the stakeholders were discussing on the perceived lack of information and education. They were saying that they do not really know what the term "ecological" entails, although they often talk about good ecological practices. Local residents feel that measures are just imposed without stakeholders understanding them. They also said that the solution is not just forbidding things, because sometimes people are already against when they hear "ecological". They also said that it is necessary to separate the environmental topics from the political topics.
What were the suggestions for environmental management in the DRN?
Regarding the water scarcity problem, the stakeholders mentioned the importance of the riparian vegetation, which are important for cooling and shadow. The stakeholders think that there is a need to take advantage of the abundance of rainwater in winter. When it rains, the water is lost from the catchment. Implementing water retention measures in the

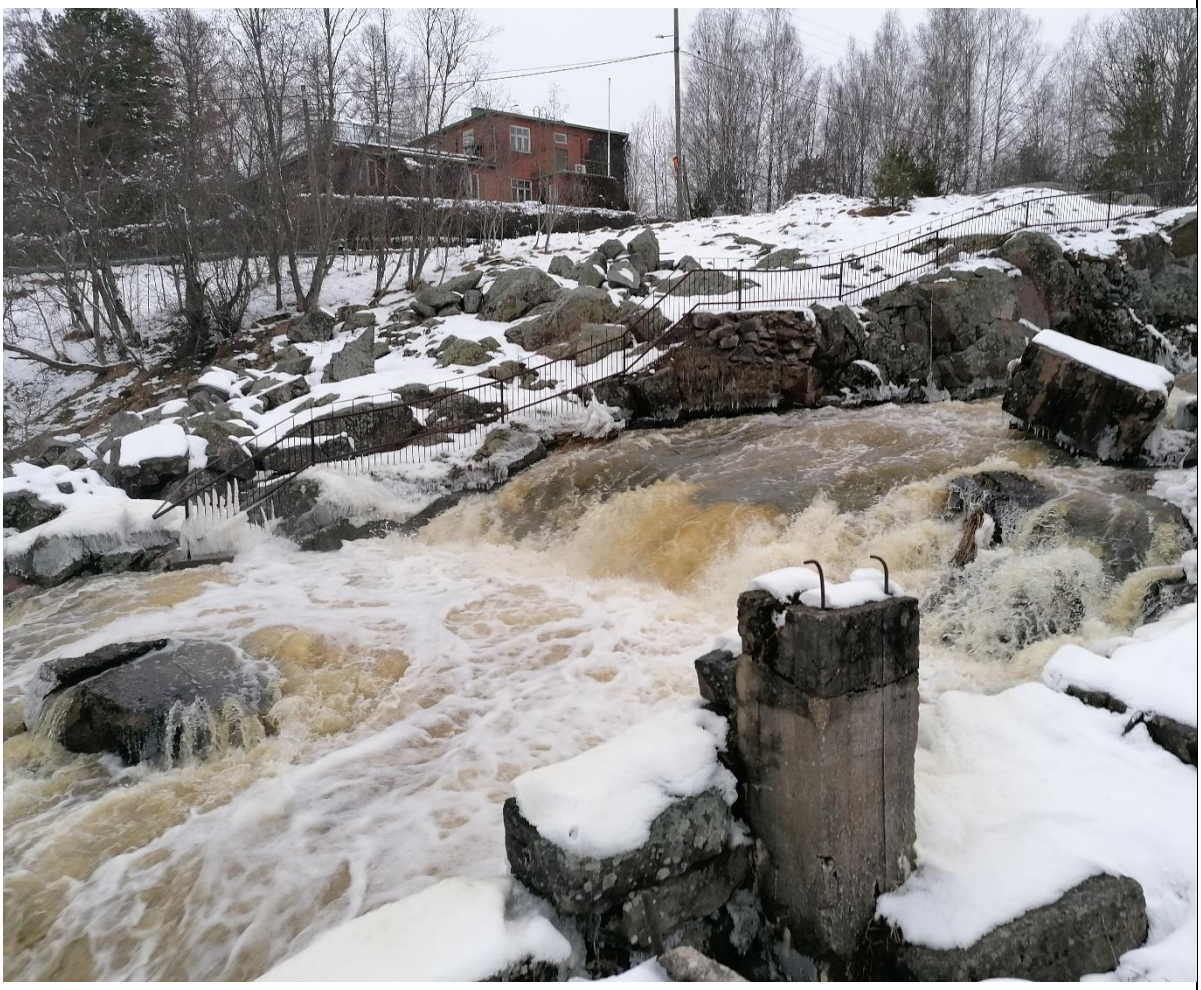
catchment could lead to water being accessible during the summer. Rivers are fragmented to ensure the fishing season and the tourism. This could be done for storage of the rainwater in winter. Some of the stakeholders said that it should be mandatory to build rainwater storage structures when building new houses in the villages. There were also different opinions on this, as there was stated that the measures that could work for some areas or departments, are not necessarily fine for all the areas. One of the stakeholders was mentioning that one could set amount of water that could be used per family or house at a fixed and affordable price and when this amount is all used up, all the extra water would more costly (the luxury consumer pays).

The discussion returned to lack of education. The education should start from the first school year ("maternelle" in France, 3 years old) and there should be a subject of "environment" in the school, just like maths. They also talk about the initiative of "autonomous village". This could start from some villages, which could be the example to be extended to all the catchments. Related to this, they mention awareness raising and communication to improve the situation.

They also mentioned the controversy about living in the city and doing recreational activities in the village. People living in the village do not necessarily show more environmentally responsible behavior than people living in the city. In the village you can also see big swimming pools in the garden, or automatic plant-watering systems. People from the village can say that they do not want people from the city to come to the village to refresh in the summer.

Finally, they also commented on a cycle path next to the river, which has been built by public money. They say that those paths already exist and that there is no need of investing such amount of public money there and that the money could be used in better initiatives.

Finland



Name of the DRN
Lepsämänjoki
When was the workshop organized?
19-20 March 2024
What is the name and the size of the river basin?
Lepsämänjoki river basin, 214 km²
What are the main ecosystem services and land use in the area?

The river basin consists mainly of agricultural land and in the upper parts there are forests. The main agricultural crop in the area is spring wheat and there are also vegetable farmers in the area. White cabbage used to be an important crop, the importance of which has decreased because there are less cabbage farmers nowadays. Fishing for recreation exists but does not have a significant role. Tourism is centred around the metropolitan area of Helsinki and not significant.
Describe the hydromorphology etc. of the DRN?
There was a total of 20 sampling locations. Biodiversity sampling took place 6 times and ecosystem functions sampling 3 times. There is high biodiversity in the area with permanent flow and nesting grounds of the fish species in the area. The main soil type is clay soil. A drying event occurred in the spring 2021 in the upper parts of the stream.
What are the main anthropogenic stressors and challenges for water management in the DRN?
The Finnish case study consists of Lepsämänjoki river basin district. Point source originates from the municipalities and diffuse pollution originates from agriculture. Water quality of the upper part of Lepsämänjoki river basin, where the agricultural areas are concentrated, has been measured since 2006 with automatic sensors, allowing long term data to emerge. The nutrient concentrations of total Phosphorus and Nitrogen have been declining in Lepsämänjoki in all the measurement points, during the past 20 years of measurements. Water quality and discharge measurement points have been marked on the map of the river basin. Several mitigation measures on nutrient load have been implemented in the area, such as buffer zones, catch crops, reduced tillage, gipsum, structural liming and winter plant cover.
Summarize the results of the discussion on past and the present?
The participants were discussing the implementation of the WFD and the environmental licensing in the area and they mentioned that there are monitoring practices in place. They were referring to the automatic measurement points and discussed the decline of overall

nutrient load. Yet they mentioned that the quantity of water has been declining and plant cover in the river basin has been increasing. During dry summers there is low quantity of water in the river. Nutrient peaks are related to high rainfall and spring and winter floods that occur during May and November-December. In the co-creation workshop the EU Common Agricultural Policy implementation was discussed. The nutrient load has been decreasing because of winter plant cover, which is one of the measures subsidised in CAP. The amount of fertilizers has been reduced as farmers aim to optimize it. Most influential measure to reduce the nutrient load was the gipsum treatment of agricultural land. There have been several projects, such as Kipsi 1 and 2 in the area, where farmers could voluntarily sign in for a program that distributes gipsum on the fields. There used to be many cabbage farmers in the area, the number of which has been declining.

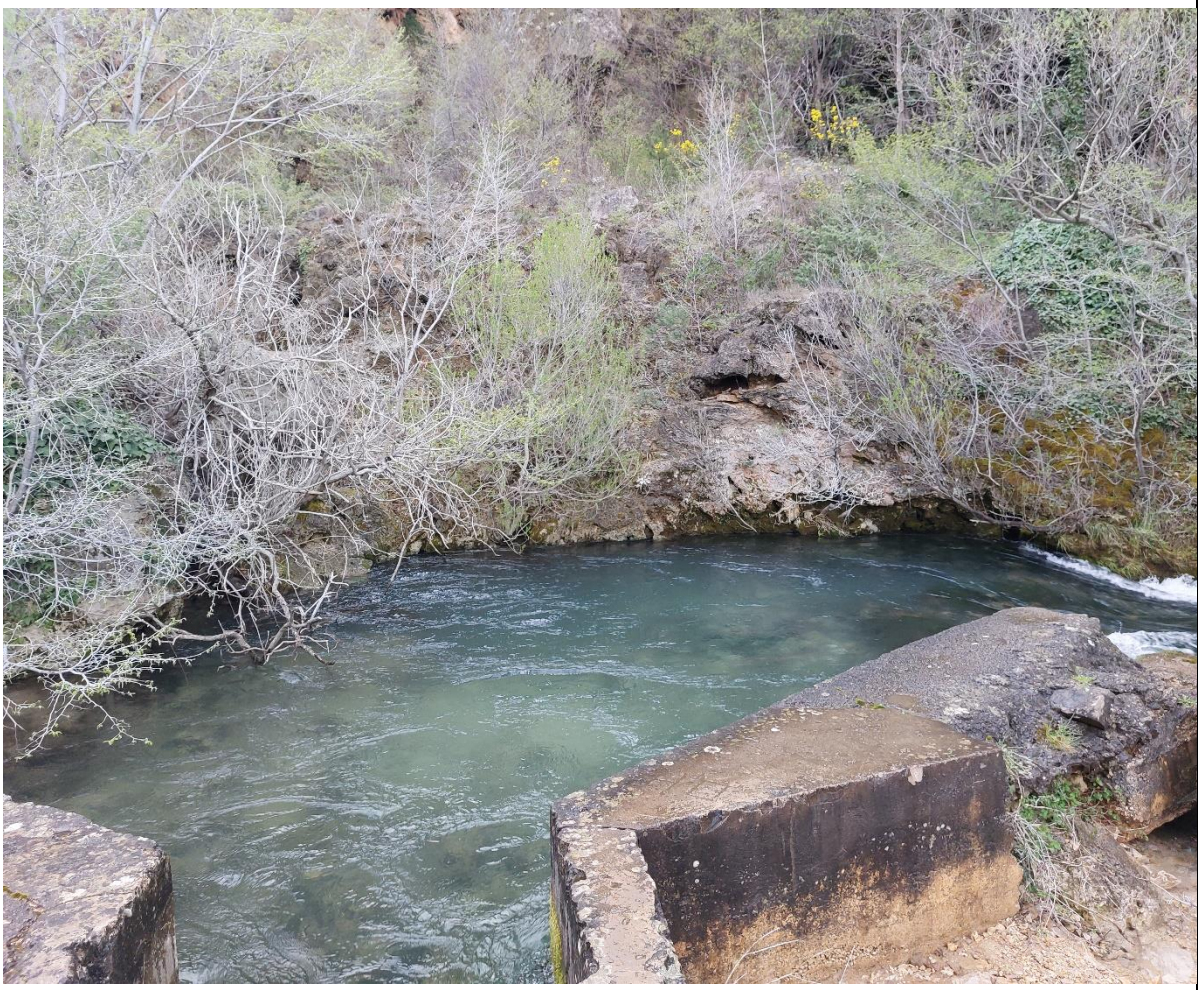
Summarize the results of the discussion on the future?

When asked about the desired future, the participants were mentioning that they would like Lepsämänjoki to reach good ecological status. They were stating that through river restoration biodiversity could be increased and flood peaks could be reduced. According to them, continuous forest cover would improve the water quality. They were saying that the river could be a source of fish protein in the future. They would like to see a river where there is enough water to swim, and which is accessible to swim where the village is located. They would also like to see the children fishing and playing at the river. They would also like to have a nature trail and spots for bird watching at the river.

What were the suggestions for environmental management in the DRN?

When the environmental management interventions were discussed, the participants were stating that subsidies for buffer zones are needed. They were stating that grey water management is needed. According to them, financing for river restoration is needed. In the regional land use plan, enough green areas should be dedicated.

Croatia



Name of the DRN
Butižnica, Croatia
When was the workshop organized?
27-29 March 2024
What is the size of the river basin?
Butižnica, 225 km^2 is a part of the 2,650 km^2 Krka watershed
What are the main ecosystem services and land use in the area?
• Fishing, recreation, agriculture • Inactive railway and industry

Describe the hydromorphology etc. of the DRN, where does the river flow, e.g. is there more forest in the upper or lower part, is there more agricultural land in the lower part?
There was a total of 20 sampling locations; 10 with constant flow, 5 intermittent and 5 which are mostly dry. The sampling also looks at the hydrogeology of the investigated streams, the flow dynamics and emphasizes how the percentage of dried-up streams is increasing, in the period from 1990 to the present day. The biodiversity of Butižnica and its tributaries is good, and there are two types of fish in this basin: Phoxinus sp. and Mediterranean trout. Most of Butižnica is a remote boarder area, which is scarcely populated. There is depopulation of the area.
What are the main anthropogenic stressors and challenges for water management in the DRN?
In the basin and in the immediate vicinity of Knin, there is a large anthropogenic influence on the rivers, primarily the Krka. There is industrial pollution in the area. Animal husbandry has been present there for centuries, now it is minimal. There is some nature tourism, hiking etc. in the area and the nature has been largely preserved. Rivers upstream of the Krka are cold, shallow and not “convenient” for swimming or rafting.
Summarize the results of the discussion on past and the present?
In the workshop, it was reported that over the past decade, some watercourses have dried up and the flows are smaller. One challenge of the river Krka is the increase of sediment in the river. There was an encroachment on the Krka around the hydropower plant and certain excavations. The changes on the Krka and Knin are also visible, reduced flow and increase in sediment. Knin's wastewater system does not work yet, and the rivers are contaminated. There is a bolt and nut factory, which releases wastewater. The stakeholders were saying that local community is expressing concern, but the city administration and the factory, as well as HEP (Croatian electrical company), are not listening. Local community has also complained

about the water use of the factory as they are pumping underground water. One participant was mentioning that she used to bathe in the river and now it is not possible because of the wastewater release. The problem is the sudden discharge from the accumulation lake (HEP), which then pollutes the river with sediment. HEP does not perform high-quality maintenance of rivers and watercourses and is still working on sewage. The fear of losing clean drinking water was expressed.

Negative changes are also observed also in Krka National Park. In the upper course of the Orašica, trout could be caught "by hand", now the ichthyofauna is extremely reduced. This can also be observed in the rest of the Krka River, where within about 15 years there has been a significant decline in the number of aquatic macroinvertebrates as well as the fish stock.

The public institution has no authority over Natura 2000, they can observe some changes and issue a warning, but they cannot prescribe penalties. There is a problem with Krčić, which became part of the Dinara Nature Park, and is no longer in the leadership of the Public Institution is that the authorities of Krčić have no longer the authority and the management of the Dinara Park. At the moment environmental destruction is happening around Krčić, and there are no authorities and nature guards who could dedicate themselves to it.

There is a military training ground where mine and explosive devices are destroyed. It is also a big problem because it ends up aerosolized in both groundwater and surface water. This training ground is of national and NATO interest, it will be difficult to remove it, and a negative impact has been observed. Local residents do not like it and they have no information when the road to the top of Dinara will be closed periodically by the army. Yet, the army has responded that they will clean-up the training ground.

Summarize the results of the discussion on the future?

The stakeholders discussed whether Butižnica should be protected and with what level of protection and what the implementation will be. They were mentioning that it is very difficult to implement a sufficient degree of protection, although it is easy to declare an area under some degree of protection, but the implementation of protection plans remains a problem. One stakeholder was mentioning that any intervention in the river basin is against

nature and that it is necessary to protect the upstream part of the Krka tributary, i.e. Butižnica. They were also saying that it would be more important to protect the fields where the area is extremely depopulated and with low anthropogenic influence. There was also a discussion on should the river basin move towards agriculture and sheep farming. The participants were also striving more towards "nature for nature" perspective of the IPBES Natures Futures Framework.

The participants were returning to the problem of Krčić and the hydroelectric power plant, which causes erosion to the riverbanks and challenges with water quality. Local associations protest and want to protect Krčić. They were also discussing whether the authority of the park could be extended to the tributaries of the Krka. The tributaries of Krka and NP might dry up if they are not protected as they are under great anthropogenic influence.

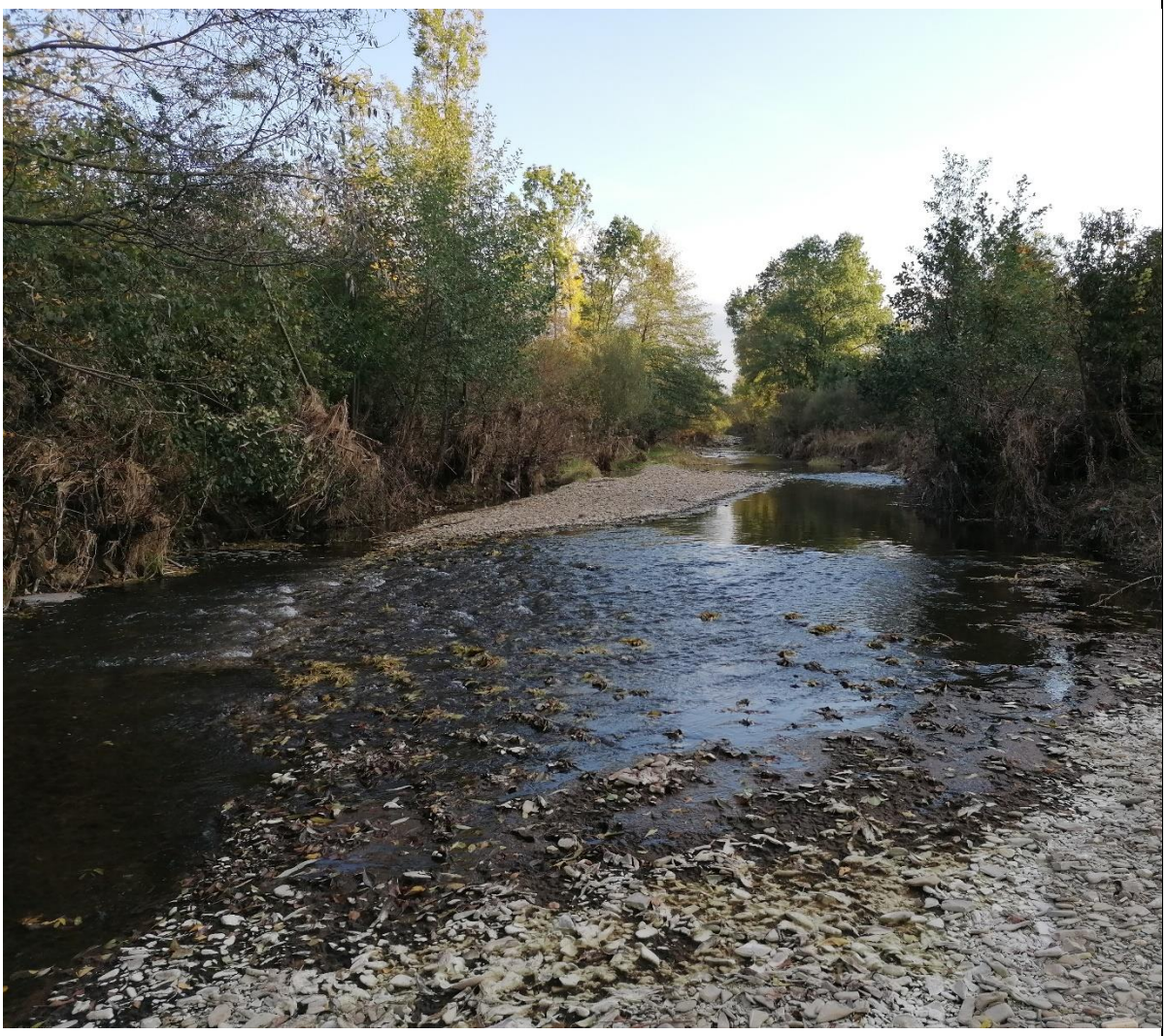
The stakeholders were discussing that the waste disposal in the city area of Knin have separate waste tanks and bulky waste can be disposed free of charge. The municipal waste system is not good enough and more and more people throw waste into nature. There are no fines for littering, but pollution can be reported on the e-communal application. The waste disposal system should be improved as the resistance to follow the municipal waste requirements impact the cleanliness of Knin.

River maintenance was seen as very important. Every year when there are heavy rains, Krčić breaks through the old wall, which was built during the hydroelectric power plant. There are more dry periods in Krčić, and there are frequent floods. The stakeholders were stating that monitoring of this area is needed, and it should involve the local community, the NGO sector, but also the scientists and professional community.

The stakeholders were mentioning that education of the population is needed, starting from kindergarten age, but it is important to educate adults as well. The Ecological Association “Krka” provides education in kindergartens and elementary schools. Educating adults is slow, but it can be done. Plastic is also a big problem, because of the vegetable packaging and plastic bags. There are no more bottles in nature. The stakeholders were mentioning that public water is important and that public taps should be constructed.

The stakeholders were concluding: “nature for people, nature for culture, and thus we will protect nature. Sustainable development must be our priority!”
What were the suggestions for environmental management in the DRN?
River basin management should be improved. The is a challenge with implementing the national legislation. Communication should be improved on all levels - population, NGO sector, City, County, Krka National Park, scientific community, private sector (tourism, ecological agriculture, etc.).

Czech Republic



Name of the DRN
Velicka, Czech Republic
When was the workshop organized?
18 October 2024
What is the size of the river basin?

Studied Velička watershed is 172 km^2, did not include lower parts of catchment (complete area of Velička is 187 km^2) due to complicated hydrology (artificial channel crossing main river stem).
What are the main ecosystem services and land use in the area?
Land use of the area consists of mostly forests in the hilly upper parts and in the lowlands mainly settlements and agricultural areas (corn and oil crops, rape seed, wine grapes). In the upper parts there is hiking tourism. There are also meadows and projects to restore them through grazing or scything (cutting). There are Natura 2000 nature reserves in the area. Some fishponds exist there, mainly for carps.
Describe the hydromorphology etc. of the DRN, where does the river flow, e.g. is there more forest in the upper or lower part, is there more agricultural land in the lower part?
There are WFD monitoring points on about 2-4 sites. The river basin is relatively well monitored for chemical and biological quality elements. The upper part of the catchment exhibits mostly near-natural channel hydromorphology while lower part is regulated and channelized with ca 50 weirs.
What are the main anthropogenic stressors and challenges for water management in the DRN?
There is eutrophication from agriculture, which is slightly decreasing. Algal blooms occur. Flash floods exist because of naturally low retention capacity catchment due to specific geology (flysch). Streams are drying annually. Sewage discharge is causing pollution of the river ecosystem.
Summarize the results of the discussion on past and the present?
Representatives from water management were talking about repairing the flood damage. They use stones and concrete to restore previous shape of the river channel especially in urbanized area. It is a challenge to the restoration project, that landowners do not want to sell their properties. River is owned by the state but the channel ends at the banks and floodplain is private property. For remeandering, there is a need for more space in the

floodplain. Inhabitants would typically own 10 m wide stripes of arable land at the riverbanks. Own plot of land was important for them during the communist times. Water management authority understands that it is important to leave room for a river, but it is hard to actualize because of the complicated landownership when restotation projects has to be negotiated with hundreds of landowners.

According to the stakeholders, wastewater treatment is another issue in the river basin. They said that the inhabitants of the river basin do not care so much about the water quality, but more about the quantity as many streams become dry with climate change in downstream section. Wastewater permits are made for streams with flow but when rivers are dry the dilution limits for wastewater stations are exceeded. There is overload of grey waters during the rainfall in urban areas witm compact surfaces. In very few villages there is a separate system for wastewater and greywaters, but not in all of them.

Summarize the results of the discussion on the future?

The stakeholders were mentioning that people are losing interest for common good, the environment and the community. They stated that there is a need for educated people to understand the complex problems. This should start from schools. There should be activities after school to care for nature. Higher education is needed, and it should train professionals with multidisciplinary skills. Also, social sciences are needed.

The stakeholders were saying that water managers have expertise on monitoring data and less about ecology. There are individuals that have ecological thinking, but this should be already in their training. Rivers should be seen as an integral part of the landscape and part of nature conservation.

What were the suggestions for environmental management in the DRN?

There should be solutions about the flash floods. Restored floodplain, small pools, and reduced size of farming block could prevent the erosion. Floodplain restoration is needed in the lower parts of the river basin. In the lower parts, floodplain and river channel is built full of concrete and there is hardly any room for restoration. In the upper parts, meadows

should be restored. Better (nature friendly) forest management should be practiced in the area. Proportion of forest area is increasing.

V. CONCLUSIONS AND POLICY RECOMMENDATIONS

Conclusions

Water Framework Directive (WFD) is the main European policy for water quality. For the past and current planning phases, implementation of the WFD has been delayed as a result of insufficient integration of environmental objectives into sectoral policies. In some DRNs, such as Budižnica, Croatia chemical pollution from the industry degrades water quality. In Albarine, France, Lepsämänjoki, Finland and in Velicka, Czech Republic sewage discharge is degrading the water quality. Therefore, attention needs to be paid on the implementation of the WFD, wastewater directive and groundwater directive.

Agricultural production is one of the main pressures on both the water quality and quantity in all DRNs that were compared in this report. Water abstraction may worsen the drying, especially in river basins with high intermittency, which are located in areas already suffering from water scarcity, such Genal, Spain, Albarine, France, Bükkösdi, Hungary, Budižnica, Croatia and Velicka, Czech Republic. Tackling diffuse pollution from agriculture remains a key challenge for Member States seeking to implement the WFD. More focus should be paid on the impacts of drying. Main coherence challenge lies between the WFD and BD (HD, BD and NRL) policies and the CAP. The objectives of the CAP scheme are to a large extent contradictory to the environmental objectives and target agricultural productivity. There are no clear linkages between the policy objectives of the CAP and the WFD and therefore they are in risk of working against each other rather than in a harmonized way. Agricultural pollution has not been reduced significantly at the European scale and it continues to be a challenge because of the lack of effectiveness and capacity to steer Member States in acting to reduce nutrient pollution from agriculture. Properly addressing nutrient pollution in the RBMPs has been difficult in the previous cycles of the WFD. The policy coherence between the WFD, the BD policies and the CAP is thus dependent on efficient national implementation of these policies.

In most DRNs the role of environmental managers as providers of monitoring data was discussed and stakeholders were expressing the need for more monitoring data. In some DRNs stakeholders were calling the need for improved environmental management and instead of only measuring and monitoring, wider understanding on the ecology was warranted (this was the case in Hungary and Czech Republic). During the co-creation session there was a discussion on defining Europe wide ecological reference state and for minimum flow ranges of ground water and surface water. Current metrics are not equipped to allow for monitoring of the ecological status. Safe operational space and minimum flow ranges of ground water and surface water are needed to safeguard rivers' ecology. These metrics should be recognized by the WFD. There is also a need to enlarge monitoring to better cover small, non-perennial streams that are not considered as water bodies and therefore often excluded from national monitoring and assessments. Scientists need to agree on reference conditions that adequately represent DRNs to reliably assess their ecological status.

Long term ecological data and hydrological modelling can provide knowledge, which is helpful for environmental management. To develop an improved framework for effective assessment and management of DRNs, it is essential to first distinguish the cause of drying in DRNs, which can be anthropogenic or natural, or a combination of both. High-resolution information about hydrological patterns and pressures within DRNs is needed to plan conservation and management of reaches prone to artificial drying. This can be achieved by modelling of hydrological regimes and hydrological connectivity and mapping of drying patterns, if long-term flow data are available.

Especially in Hungary, citizen-science was discussed because of the wide application of DryRivers App. Citizen science can inform adaptive management, as it has great potential to involve citizens and inform them about the pressing environmental challenges. Besides citizen science, local knowledge is also key to understand the causes of drying, which is accelerated by climate change and enforcing habitats fragmentation.

In many DRNs (Spain, Finland, and Czech Republic) river restoration was mentioned as a way to improve the connectivity, water quality and biodiversity of river systems. By restoring rivers and recovering ecological functions of rivers, migration of aquatic species can be ensured. Dam and barrier removal, removing small scale hydropower and restoring environmental

flows are the ways to improve rivers connectivity. Water governance that recognizes the variety of local socio-ecological systems is key to successful river restoration. NRL can support these activities with a binding target of restoring European habitats.

It is essential to overcome the operational challenges for biodiversity conservation in river networks and to establish pathways for river restoration. For restoring rivers and their ecological functions, ensuring species dispersal is essential. DRNs should be restored in accordance with the EU Biodiversity Strategy objectives and other relevant legislation, such as Habitats Directive and Nature Restoration Law to safeguard multiple ecological functions provided by the river ecosystems. Climate change adaptation should be considered in restoration policy and other policy sectors. To so do, non-perennial segments should be considered as integral part of the river network. There is a need to overcome the operational challenges for biodiversity conservation in river networks and to establish pathways for river restoration.

In some DRNs (France and Czech Republic) stakeholders participating in the workshop were calling for improved environmental education. They were stating that schools and afternoon activities should have a greater role in establishing a nature connection. There is a need to encourage adaptive management that aims to safeguard ecosystem functions and services provided by intermittent and drying rivers. Water loss can be limited through implementation of NBS and land use change to retain and recycle water, which should be supported by European policies. For example, the update of WFD Common Implementation Strategy workplan (CIS, 2025) could include actions to improve the management of non-perennial river segments, including improved monitoring e.g. to quantitatively estimating to what degree drying is due to anthropogenic stressors drying frequencies, magnitudes, and durations that could push communities or ecosystems to less desirable states, with particular attention to thresholds leading to alternative stable states. Adaptive management that also aims to safeguard ecosystem functions and services and allows experimentation and learning is needed. Legal frameworks should be adaptive towards the scientific evidence provided on the changing habitats.

Policy recommendations for adaptive management of DRN

The DRYvER project recommends the following policy actions for improved management of Drying River Network:

Issue: Non-perennial river segments should be recognized as a water body including their definition by the Water Framework Directive and its implementation strategy. The cause of drying should also be clearly identified to define types of non-perennial river segments.

Background: The WFD defines 'rivers' as "a body of inland water flowing for the most part on the surface of the land, but which may flow underground for part of its course" and does not explicitly refer to non-perennial rivers and streams. However, the WFD Annex II refers to the need of classifying the surface water bodies by different types and considers the water flow as one of the criteria. In fact, several Mediterranean member states - Cyprus, Italy, Portugal, Slovenia, Spain - have defined the type "R-M5 Temporary streams" and intercalibrated their national classification systems – primarily using the quality element of macrobenthos - via the Council Decision 2018/229.

Problem: (1) non-perennial river segments — those that recurrently cease to flow or frequently dry — occur in all river networks; and most of these stretches are not included in river networks and water management under the WFD. (2) In addition, climate change and water storage and abstraction pressures are altering the drying regimes of river networks and in many areas, the prevalence of drying increases or decreases. Such deterioration may take place unnoticed by the WFD status assessments. (3) The ecological consequences of increased drying are still poorly explored but presumably more dramatic than for naturally drying river networks due to the lack of adaptations of the constituent's species.

Policy relevance and opportunities: The 2024 EEA report on the State of Water and the 2019 WFD Fitness Check show that the water acquis is fit for purpose, but there are major implementation constraints at member state level. However, the deterioration of drying river networks is neither properly recognized nor monitored in the River Basin Management Plans beyond the topic of reduced water availability for water users. Drying and associated biodiversity loss might be important elements of the expected Water Resilience Initiative and the Nature Restoration Law.

DRYvER is giving specific policy recommendations on the adaptive management on European and DRN level:

1. 1. Other types of non-perennial rivers shall be defined for non-Mediterranean areas, following the rivers assessed by DRYvER and based on causes of drying and drying regime.

2. Other types of non-perennial rivers shall be defined for non-Mediterranean areas, following the rivers assessed by DRYvER and based on causes of drying and drying regime.

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VII. Photo sources

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