Poplar Commission of the Republic of Slovenia

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Cultivation and Utilization of Poplars, Willows and Other Fast-Growing Trees in Slovenia

Report of the National Poplar Commission

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Dr. Gregor Bozic
Slovenian Forestry Institute
Department of Forest Physiology and Genetics
Vecna pot 2
SI-1000 Ljubljana
Slovenia

E-mail: gregor.bozic@gozdis.si

I. POLICY AND LEGAL FRAMEWORK

Slovenia has a forest area of 1,176,542 ha based on data from 2023. This accounts for 58% of its territory (SFS 2024), ranking it third of 27 countries in the EU. The average growing stock is also the third highest, of approx. 330 m^3/ha (Forest Europe 2020). The site conditions are particularly favorable for the development of high forests. 70% of the forests are located within the natural distribution area of predominantly beech, fir-beech and beech-oak sites with high production capacity. As Slovenia is a mountainous country, the possibilities for intensive fast-growing trees plantations are limited. Forestry and forest management are traditionally based on sustainable, close-to-nature principles. 37.16% (7,684 km2) of the total territory is included in Natura 2000 and 71% of the Natura 2000 areas are covered by forest. The possibility of introducing non-native species is therefore clearly limited by national and European legislation as well as international agreements on biodiversity.

The wood processing industry for fast-growing trees is not well developed in Slovenia. The most important plantations of fast-growing trees are in the sub-Pannonian region along the Mura and Drava rivers in the area of the Mura-Drava-Danube Transboundary Biosphere Reserve, the largest and best-preserved natural river system in Central Europe. The Mura, Drava and Danube rivers form a 700-km long, interconnecting corridor of floodplain river ecosystems in the Danube River Basin with hotspots of rare and/or endangered species and connect about one million ha of habitats in the five countries. The Mura River Biosphere Reserve (MR BR) was declared a biosphere reserve in Slovenia (https://en.unesco.org/biosphere/eu-na/mura-river) in 2018. In 2021 it became part of the five-country Mura-Drava-Danube Biosphere Reserve (MDD BR) in the UNESCO MAB program.

The riparian forests of the Mura-Drava-Danube Biosphere Reserve, which form ecological corridors, are in poor condition and are declining due to the increasing incidence of pests and diseases, unsustainable human activities, and a lack of guidance on how to manage riparian forests, including where to find appropriate planting material for them so that they can continue to exist and provide all ecosystem services. Forest management strategies that take into account climate change due to natural conditions and risks as well as wildlife pressure should not be neglected. The interactions among abiotic and biotic stressors are likely to become the main factors for the occurrence of pest and disease outbreaks (Kovac and Sallmannshofer 2021). There is great concern as to whether native tree species will be able to cope with the rapid climatic changes and the novel impacts of pests and diseases. Floodplain forests are particularly susceptible to invasion by non-native plant species due to high nutrient availability and recurrent disturbances leading to favorable light conditions.

In Slovenia the main efforts are focused on the forest and conservation management of riparian forests as part of the following EU-funded projects: REFOCuS – Resilient riparian forests as ecological corridors in the Mura-Drava-Danube Biosphere Reserve (https://keep.eu/projects/19494/Resilient-riparian-forests–EN/), Natura Mura - Restoration of wetland habitats along the Mura (https://natura-mura.eu/), zaDravo – Drava Natura 2000. River for the future: Improving the conservation status of species and habitat types of the river and river basin of the Drava River (https://www.gov.si/zbirke/projekti-in-programi/zadravo/), and LIFE RESTORE for MDD – Preserving and restoring floodplain forest habitats along the Mura-Drava-Danube rivers (http://www.amazon-of-europe.com/en/liferestoreformdd/). Harmonizing the development of riparian forests with the various ecosystem services requires incorporating new approaches into the paradigm of sustainable forest management and its practice. Further

efforts are needed to better understand biodiversity, disturbances, and their impact on forest management practices.

The area of production plantations of fast-growing trees located in the Mura River Biosphere Reserve has declined and will continue to decline in the future as more natural forest management is promoted under the National Forest Program and the Natura 2000 Management Program. The establishment of poplar tree plantations with short rotation periods and/or longer production cycles in the future will be limited to the most suitable sites on arable land outside the designated core areas and buffer zones of Natura 2000 sites. They will be used mainly to ensure an additional supply of fuelwood biomass from areas with intensive agricultural production in order to reduce the existing high pressure on the endangered lowland forests and, partly, to supply the wood processing industry.

The potential for the use of fast-growing trees in intensive systems will be of greater importance in supporting green technologies for climate change adaptation in urban and peri-urban environments as well as in the use of specially approved genotypes (clones) of poplar, willow and black locust trees for the remediation and buffering of polluted land. Wastewater and stormwater treatment plants based on short rotation willow coppice are a recognized solution abroad. An attempt to introduce such a system on a pilot scale in Slovenia encountered institutional and legal obstacles that hindered its implementation. The University of Ljubljana, Slovenia, designed and planned a pilot stormwater management system using the fast growing clone of white willow 'V 052' (*S. alba* L. var. *calva* G.F.W.Mey x *S. alba* L.). This pilot plant should have provided storage, evapotranspiration and treatment of stormwater runoff from a car park. In addition to stormwater management, the system would have provided other benefits such as urban heat island mitigation, biodiversity, aesthetic appearance, and the production of wood chips that could be used as mulch for nearby parkland. The system was to be implemented in the urban landscape park Tivoli, Roznik and Siska Hill in the green surroundings of the Slovenian capital to contribute to stormwater management in the park. However, since the urban park is designated as a nature reserve of special interest, the Institute of the Republic of Slovenia for Nature Conservation (IRSNC) has expressed its concern that the uncontrolled spread of seeds of fast-growing clones of white willow to other parts of the park could not be prevented with certainty, which poses a risk for the uncontrolled spread of non-native clones, even though the willows would be cut down every two to three years in a coppice system.

On the one hand, this example shows the need to develop and implement nature-based solutions based on fast-growing trees, which have great potential for water treatment and a variety of co-benefits that are particularly important for improving the resilience and climate adaptation of urban areas. On the other hand, the introduction of non-native clones of fast-growing trees is of increasing concern to nature conservationists. There is a need to implement demonstrative pilot plants of such systems that would be monitored for risks and demonstrate the performance of the treatment as well as the co-benefits. Such pilots would support research and awareness-raising among local decision-makers (municipalities), nature conservation organizations, scientists, water utilities and forestry institutions.

In Slovenia, the doctrine of forestry is orientated towards sustainable management. It is very conservative when it comes to introducing non-native tree species or their artificial hybrids into forests or non-forest areas. From a nature conservation perspective, non-native species do not belong in our area. However, if fast-growing trees are introduced outside the natural environment, e.g. in urban areas, different rules should apply to the use of non-native clones. The selection of suitable species/clones should be made based on the objectives of the nature-

based solutions applied in order to combine the greatest environmental benefits (e.g. mitigation of urban flooding and heat islands in cities, increasing biodiversity and landscaping) with the least risk to nature (uncontrolled spread of non-native clones via pollen or vegetative propagation). Therefore, areas suitable for the use of fast-growing species should be identified and mapped.

No subsidies for the cultivation and production of poplars and/or willows exist to date.

National policies, laws or regulations concerning the cultivation or utilization of poplars, willows and other fast-growing trees in natural forests, planted forests, forest plantations and agroforestry

The Forest Act (1993) regulates the protection, silviculture, and utilization of forests following the principles of protecting the environment and natural values, long-term and optimal functioning of forests as ecosystems, and the facilitation of their functions.

The habitats of native plant and animal species must be preserved or newly created in forests as stipulated in the forest management plans. The natural structure and species composition should be gradually restored in altered forests. Under this Act, a forest plantation is not considered forest. A forest plantation is governed by provisions of the Regulation on the Use of Agricultural Land for Forest Plantations (1986). The establishment of forest plantations is permitted on marginal agricultural land or poor soils that have too much or too little water for agricultural production. Short rotation coppice plantations (SRC) have been classified as eligible permanent crops. The plantation area can be converted back to food production at any time without having to apply for authorization for clearing and conversion. This also implies that no afforestation authorization is required for the establishment of forest plantations and short-rotation plantations outside the forest land. This approach is intended to facilitate the establishment of forest plantations and short-rotation plantations outside of forests.

The Forest Reproductive Material Act (2002) regulates production, marketing, and use of high-quality forest reproductive material suitable for different site conditions in order to enable the sustainable and optimal operation of forest ecosystems and their renewal in compliance with the principles of protection of forest genetic resources. It includes the reproductive material of forest tree species and hybrids important for forestry purposes to be used for: regeneration with planting or seeding, afforestation, maintenance of permanent buffer or anti-erosion zones of forest trees and design and maintenance of forest plantations. Based on the Forest Reproductive Material Act, there is a list of tree species and artificial hybrids (2010) for which the regulations of FRM apply. The list contains 77 forest tree species including *Populus* x spp.*, *Salix* x spp. and *Robinia pseudoacacia,* while *Juglans nigra* is not yet included. There are Rules on the conditions for the approval of forest seed object in the category "source of origin" and "selected" (2003) and Rules on the conditions and procedures for the approval of forest seed objects for the production of forest reproductive material in the category "qualified" and "tested" (2004). In Slovenia, the production of forest reproductive material (FRM) of poplar and willow species and their artificial hybrids to be marketed must be based on basic material in the category "Selected", "Qualified" or "Tested".

The Nature Conservation Act (2004) and the Regulation on Special Protection Areas (Natura 2000) (2004) set out measures to conserve biodiversity and a system for protecting natural

values. In nature conservation guidelines for particular priority habitat types and species, zones with specific guidelines are determined in order to achieve more detailed protection goals for the conservation of protected habitat types and species in Natura 2000. The Nature Conservation Act does not prohibit non-native tree species in general. It allows the use of non-native species for forestry activities if they are already present in an area, while the introduction of new species requires the approval of the Ministry. The introduction of plants or animals of non-native species and the introduction of genetically modified organisms is prohibited within Natura 2000. Nature protection guidelines are prepared by the Slovenian Institute for Nature Conservation and included in all forest management plans prepared by the Slovenia Forest Service (SFS) at the local forest unit level. For forest management plans prepared for forest units in Natura 2000 sites, additional specific guidelines and measures are required to achieve more detailed protection objectives set out in nature protection guidelines of the Institute of the Republic of Slovenia for Nature Conservation.

In forestry and conservation legislation, legislators are continually faced with the challenge of balancing their commitment to protecting the environment as set against the risk that non-native tree species will threaten biodiversity and native ecosystems, while allowing for the benefits and opportunities that many non-native tree species bring (Adamic et al., 2022).

II. TECHNICAL INFORMATION

1. Taxonomy, Nomenclature, and Registration

To date, no basic material has been approved for the production of forest reproductive material on the basis of experimental plantations. To date, no clonal stoolbeds have been approved by the authorities. There is currently no register of clones, clonal mixtures, in Slovenia. The main reason for this is that the importance of using poplar or willow clones has not been recognized by the government authorities and the timber wood processing sector.

2. Domestication, Breeding and Selection of Genetic Resources

a) *Aigeiros* section: European black poplar

The native *Populus nigra* is still preserved in small locations along the main rivers and their tributaries on alluvial sites. In stands, they are present as individual trees (solitary trees) or in small groups of over-mature trees. The wide floodplain systems along the Mura and Drava rivers are characterized by a metapopulation structure of local populations.

Efforts are being made to preserve the remaining populations through *in situ* and *ex situ* measures along Mura and Drava Rivers. Most conservation measures focus on the protection of riparian forest ecosystems and revitalization of endangered forest habitat types.

The SFI leads both an *in situ* and *ex situ* conservation program for *Populus nigra*. As part of the Drava – Natura 2000 project, led by the IRSNC Maribor Regional Unit, SFI has selected 81 mature *Populus nigra* trees of good phenotypic appearance and health. The selected trees were mapped in natural stands, measured, tree traits and site characteristics described, sex determined, and samples taken for molecular check of species purity for certification. The samples of European black poplar were genotyped with two types of genetic markers. 1)

Amplified sequence length polymorphism markers: win3 and 2) *Short sequence repeat (microsatellite) markers*: ORNL214, WPMS09, WPMS14, WPMS15, WPMS16, WPMS17, WPMS20, PMGC14, ASP112322, PTR8, ORPM86, YIN2, GCPM1719, PTR4, ORPM344, and GCPM1894. The most promising trees were selected as plus trees and vegetatively propagated in the SFI greenhouse. A new clonal archive with 32 genotypes (153 plants) was established in the SFI experimental nursery in central Slovenia in spring 2022. Due to natural hazards (extended period of drought with extremely hot weather in the first years) the gene archive was duplicated (24 genotypes) and additionally planted in pedologically wetter site conditions in an experimental area of the Croatian Forestry Research Institute in Jastrebarsko for further testing. In 2023, all 32 genotypes of *Populus nigra* were transported to the forest nursery Turnisce (Izakovci) in NE Slovenia. We expect to be able to identify several clones of the native black poplar for subsequent introduction for use in forestry in Slovenia.

Officially one seed stand of *Populus nigra* (2.8 ha) in the category Selected, which is also declared as a genetic conservation unit, and five plus trees are approved in Slovenia.

b) *Leuce* section: white poplar, aspen, and gray poplar

The white poplar (***Populus alba* L.**) is indigenous and the least common fast-growing tree species among the native poplars in Slovenia. Although it is infrequent, it is widespread almost all over the country. Data on the occurrence of white poplar in Slovenian forests are rare. It is more common in the Podravje region. It is mostly present at an elevation of 80–215 meters and is potentially endangered due to its low and rare occurrence as well as due to habitat destruction in the past.

The SFI leads a program for the *in situ* conservation of *Populus alba*. As part of the Drava – Natura 2000 and Natura Mura projects led by the IRSNC, SFI selected 61 *Populus alba* mature trees of good phenotypic appearance and health status based on morphology. The trees were selected in riparian mixed natural stands in close cooperation with the SFS. Selected trees were mapped by GPS, measured, the plant and site characteristics described, and the sex determined for certification. A total of 32 *Populus alba* trees were selected as plus tree candidates. Two seed stands of *Populus alba* (0.7 ha) in the category Selected and 22 plus trees are officially approved in Slovenia.

Professional guidelines for growing plants from generative seed production and vegetative clone reproduction material of white poplar have been established, focusing on the practical directions of the forest nursery (Bozic 2022). The management of riparian forests and conservation activities along the Drava River were published by various authors in a special issue of the journal Proteus in 2023.

The gray poplar (***Populus* × *canescens* (Ait.) Sm.**) is a spontaneous hybrid of aspen and white poplar. Hybridization between the two species goes in both directions and therefore poses a constant potential threat to the conservation of pure native species gene pools. In Slovenia it might be present along the Drava River (Bozic 2022) and especially in areas of their ecological overlaps.

The Eurasian aspen (***Populus tremula* L.**) is a rare but naturally widespread fast-growing tree species in Slovenia. It can tolerate a wide range of habitat conditions and typically colonizes disturbed areas after fires, sleet, windthrow, and calamities. As a pioneer species aspen is used for afforestation of bare land. In stands it appears as individual trees or in small groups. It grows

naturally from the lowlands up to elevations of 1430 m above sea level. Forest stands with aspen cover 53,806 hectares. It is found to a greater extent in the southern, western, and eastern parts of the country. The wood is mainly used for energy purposes as fuelwood from forests.

c) ***Tacamahaca*** **section and other poplar species from** ***Aigeiros*****,** ***Leuce s*****ections**

A national archive of poplar clones from the *Tachamahaca, Aigeiros* and *Leuce* Sections is regularly maintained in the SFI experimental nursery near Ljubljana. The 30 most bio-ecologically suitable and productive poplar clones for wood production in long rotations tested in Slovenia are included in the living archive and maintained by SFI. The genetic archive also serves as a source for the collection of vegetative reproductive material for scientific purposes and genetic analyses.

d) **Willows**

Native willows in Slovenia are: *Salix alba, Salix fragilis, Salix x rubens, Salix eleagnos, Salix purpurea, Salix fragilis, Salix viminalis, Salix cinerea, Salix triandra, Salix myrsinifolia, Salix petandra,* and *Salix daphnoides* (Dakskobler et al., 2013). Most willow (and European black poplar) communities are classified in the *Saliceta purpureae* class.

Officially one seed stand of *Salix alba* (2.8 ha) in the category Source identified, five seed stands of *Salix alba* in the category Selected (22.1 ha) and five plus trees are approved in Slovenia.

e) **Fast-growing tree species with similar attributes in terms of industry and energy uses and environmental applications to poplars and willows which were recognized as important by the Poplar Commission in Slovenia**

Even though production is limited and restricted, black locust and black walnut are important non-native fast- growing broadleaf tree species that are of great benefit to forest owners and other stakeholders. Research is needed to optimize the use of certain tree species.

The black locust (***Robinia pseudoacacia*** **L.**) is one of the earliest introduced non-native tree species in Slovenia and is widely used for afforestation of degraded lands (Brus and Gajsek 2014). As a pioneer species, the black locust rapidly colonizes forest gaps and degraded areas. It is a naturally regenerating species with invasive uncontrolled expansion, especially in sub-Pannonian (NE Slovenia) and sub-Mediterranean (SW Slovenia) ecological regions of provenance, and therefore undesirable in the concept of sustainable and co-natural forest management (Kutnar and Kobler, 2013). The available climate change scenarios and the empirical model used by Kutnar and Kobler (2013) predict a further increase in the proportion of the black locust's growing stock in Slovenian forests.

Due to its long history in Slovenia, the black locust could also be declared as a domesticated tree species. Since the experience with the black locust in some parts of the country so far has been mostly positive (soil improvement due to nitrogen assimilation, durable wood, beekeeping), it could also be one of the most competitive tree species in Slovenia. Despite being allochthonous, it will increase the value of the adaptation of forest and forestry to climate change (Bahor and Klopcic, 2019). Although the black locust is widely known for its high-

quality timber production and other benefits, it is not intensively managed in Slovenia. The stem quality for industrial use is predominantly poor. Therefore, it is mainly used by forest owners or sold as firewood or wood for fences and vineyard trellises due to its highly durable timber (Brus et al., 2017).
The advantage of black locust is its ability to grow in marginal degraded areas where the native species cannot grow and therefore it can be a good strategy for environmental restorations in special cases (Monteverdi et al., 2017). Due to its high adaptability to different site conditions, fast growth, and vegetative propagation, it has good potential for energy biomass production in short rotation cycles on poor soils and degraded areas as well as in coppice forestry. The main disadvantage is the risk of invasiveness and loss of biodiversity due to higher competitiveness in comparison with native species. In close canopy forest, it is considered non-invasive (Konnert and Spiecker 2017). Any decision on the use of black locust should be well planned and regulated. There is an urgent need to avoid SRC black locust plantations in close vicinity of the reserves as well as in endangered habitats to prevent further invasion in times of global warming.

The black walnut (***Juglans nigra*** L.) in Slovenia currently exists only in the form of remnants of former wider black walnut planted forest complexes as well as in forest plantations in the Prekmurje region, Velika Nedelja, and Kostanjevica na Krki. It is a naturally regenerating but non-invasive species. The black walnut in Slovenia shows high productivity and has the highest wood price of all non-native species in the market. There is a need to start a breeding program of *Juglans nigra* for wood production with experimental sites to compare different provenances and genotypes regarding the growth characteristics, shape, and resistance to biotic and abiotic stresses.

The Slovenian Forest Service proposed adaptive management to respond to climate change whereby non-native tree species, including black walnut, should only be used to a limited extent. Its re-use has been justified by gap-filling in forest ecosystems after the possible loss of the endangered ash species sensitive to pests and outbreaks resulting from climate change. The planting of these tree species is only possible if this is allowed by relevant forestry and nature protection legislation. Any decision to plant alien tree species should be taken carefully; it must be well planned and the measures must be monitored.

Non-native tree species should not be planted in Natura 2000 sites or other designated protected areas where it is important to ensure the long-term health of the ecosystem and the stability of the various indigenous habitats.

3. Plant Health, Resilience to Threats and Climate Change

a) Poplar nursery

The health status of all reproductive material (regarding the requirements about FRM health status by the Council Directive 1999/105/EC of 22 December 1999 on the marketing of forest reproductive material) in the poplar nursery is inspected twice a year by the Slovenian Forestry Institute, which is authorized by the ministry responsible for the forestry sector to officially supervise the health of all reproductive materials for forest plantings; the inspection is carried out in cooperation with forest inspection. The phytosanitary measures are prescribed by the forest inspectors and are mandatory for nursery managers. The implementation of the measures

prescribed is monitored by forest inspectors. In addition, the presence/absence of quarantine pests and RNQP for the EU has to be regularly checked by the nursery, and is under supervision of forest inspection Regulation (EU) 2016/2031 on protective measures against plant pests.

The most frequently observed diseases in the poplar nursery were poplar leaf rusts (*Melampsora* spp.) and marssonina leaf-spot of poplar (*Drepanopeziza punctiformis*, syn. *Marssonina brunnea*). In some favorable years for the spread of these diseases, up to seven fungicide applications were performed in nurseries. Occasionally, dothichiza bark necrosis of poplar (*Cryptodiaporthe populea*, syn. *Dothichiza populea*) was detected in nurseries. In such cases, the diseased propagation material was forbidden to be marketed and phytosanitary measures were prescribed. The most frequently observed pest was *Chrysomela populi*, which was regularly controlled by insecticide applications. *Sciapteron tabaniformis* and *Saperda populnea* were often found in poplar nurseries but caused little damage. In 2022, the poplar nursery in Izakovci was heavily damaged by hail. Consequently, an outbreak of *Cryptodiaporthe populea* was recorded. The infected plants were removed and destroyed.

b) Poplar plantations, poplars in managed forests

Poplars have been felled mostly due to wind and complex disease which is caused by several damaging agents. A decline in the long-term vitality of poplars has been observed as a result of climate change. Other damaging agents causing the felling of poplar trees were: *Armillaria* spp., Eurasian beaver (*Castor fiber*), European mistletoe (*Viscum album*), lighting strikes and droughts. Droughts are believed to be the most important factor in the long-term decline of poplar health.

The most frequently observed diseases were caused by *Cytospora* sp., *Diaporthe* sp., *Botryosphaeria* sp., *Eutypa lata*, *Neocosmospora silvicola*, *Neocucurbitaria salicis-albae*, and poplar rusts. Dieback of a newly planted avenue with poplars was observed due to drought; subsequently, it was destroyed by drought-related pathogens.

c) Willows

Willows have been felled mostly due to strong winds, complex disease, *Armillaria* spp., and beaver (*Castor fiber*). Minor damaging factors have included drought, European mistletoe, rodents and mechanical damage. In the case of one avenue, willows were primarily affected by drought and secondarily by several pests such as *Agrilus* sp., *Xyleborinus saxeseni* and *Helicomyia saliciperda*.

d) Other fast-growing trees (*Robinia pseudoacacia* and *Juglans nigra*)

The black locust (*Robinia pseudoacacia*) has been affected mainly by strong winds, complex disease, drought, *Armillaria* sp., *Viscum album*, rodents, and beavers. Leaves of black locust are increasingly damaged by various invasive alien species: *Parectopa robiniella*, *Macrosaccus robiniella*, and *Obolodiplosis robiniae*. Root rot caused by wood decay fungi lowers the mechanical stability of black locust trees and consequently winds can easily topple them.

The health status of black walnut (*Juglans nigra*) has been affected mainly by complex disease, wind, and European mistletoe.

4. Production systems for the bioeconomy

(a) Nursery practices and propagation techniques including applications of biotechnology – particularly plant propagation, reproductive materials, use of GMOs, etc.

Forest nurseries in Slovenia collect seeds and cuttings for their own needs in officially approved forest seed facilities. To maintain genetic diversity, it is best to collect seed in full mast years, when most trees in a given stand have contributed to the production of seed. Consequently, the seed lots collected at this time represent the genetic variation of the entire stand. We recommend collecting seed from at least 25 unrelated trees, distributed over the entire seed stand. Equal quantities of seed should be collected from each tree. The higher the number of trees for seed collection, the better. Mixing seed lots can increase genetic diversity. It is generally permitted if the source material comes from the same region of origin and the process of mixing is documented. The right timing of seed harvesting is crucial. The first seeds to fall are usually dead or infected with insects or fungi and should therefore not be collected. There is no import of seeds and plant parts or cuttings from countries outside the EU for use in forestry. It is possible to import seeds and seedlings from abroad, but each time the import is subject to the expert opinion of the competent authority (which is the Slovenian Forestry Institute). Since 2023, seedlings in tree nurseries must also undergo phytopathological testing of soil substrates (this is especially important for *Phytophthora* spp.) before they are transferred to Slovenia.

The forestry nursery Turnisce maintains collections of *Populus nigra, Salix alba* genotypes propagated clonally from old and genetically pure trees of the Mura River and the Drava River floodplain forests. Turnisce specializes in the production of fast-growing species, which fulfills the demands for the sub-Panonnian region of provenance. The nursery produces *Populus nigra, Populus alba* and *Salix alba* seedlings as well as poplar clones *Populus* × *canadensis* cl. Pannonia (syn. M1), *Populus deltoides* cl. 457, and *Populus deltoides* cl. S1-8 and sells them at the age of two or three years on the local market. Nursery production capacity of fast-growing trees is 10,000 per year.

The use of the site-adapted (or pre-adapted) seeds or planting material of native species of high genetic diversity, high quality, and increased tolerance/resistance properties is considered as the primary option for artificial regeneration, afforestation, or habitat reconstruction activities. The use of GMOs is forbidden. To support the production of FRM for riparian and floodplain forest users, researchers from the SFI, in collaboration with REFOCuS project partners, have produced *Guidelines for the production of planting material for restoration of riparian forests.* These guidelines are available free online in the English language DOI: 10.20315/SFS.170. Additionally, *Populus nigra* and *Populus alba* protocols for seedlings production from seeds by generative production were prepared by SFI. Breeding *Populus nigra* seedlings from seeds is a rarely used method of reproduction. There is a need to find the most suitable protocol for breeding quality seedlings in regional conditions.

The use of GMOs is forbidden.

(b) **Planted forests with emphasis on the choice of cultivars, type of plants, spacing and layout of plantations; planting and tending (fertilization, irrigation, weeding, pruning, thinning etc.); management (growth, rotation in relation to yields and industrial requirements)**

Extreme forest sites such as riparian ecosystems heavily affected by material displacement and sedimentation as well as forests that are affected by natural hazards (e.g. beetle infestations and diseases, windthrow) require planted forests. As part of projects carried out by the IRSNC, 14 ha of old poplar plantations on alluvial forest sites along the Mura River were cut down and replanted with native European black poplar and white willow seedlings to establish more natural forest structures in the Natura 2000 area.

In recent decades, the area of poplar plantations has been decreasing annually, as the main potential areas for establishing production plantations have been along riverbanks and in floodplains up to 300 meters above sea level, where we must take into consideration the conservation of the natural habitats of Natura 2000 and natural genetic resources of the native tree species. Transition forests include heavily transformed, artificial forests or intensively managed plantations. According to the data we gathered, the area of plantations with poplars for use over longer production periods on non-forested areas in Slovenia has continuously decreased from 1944 ha in 1984 to 235 ha in 2023. In the reporting period of four years only one new productive plantation of one ha was established with *P.* × *canadensis* cl. Panonnia (syn. M1) and *Populus deltoides* cl. 457. In recent decades, planted forests have disappeared, largely due to the promotion of naturally regenerating forests. To date, no subsidies for poplar and/or willow cultivation and production have been granted.

An EU-POP experimental plantation for testing 25 poplar clones from EU member states (spacing 1m x 3m, 40 seedlings/plot, 25 plots/block, 3 blocks) in longer cycles planted in the area with heavier soil conditions is maintained regularly by the Slovenian Forestry Institute (SFI) in close cooperation with the Slovenia State Forestry Company (SiDG). The most promising clones are AF-8 (t x d), AF-18 (d x n), AF-34 (d x n), Bakan (t x m) and Skado (t x m). SFI also regularly manages the experimental plantation for testing the Slovenian *Populus nigra* clone PN-6 and Austrian *Populus nigra* clones (TA048, TA152, TA155) in heavier soil conditions in comparison with cl. Pannonia (syn. M1) and cl. S1-8.

(c) Naturally regenerating forest, with emphasis on experiences and experiments concerning silvicultural treatments, harvesting, management, protection and regeneration

- Natural regeneration is extremely difficult to achieve in riparian forest due to dense ground vegetation and therefore requires human intervention. In cases where ground vegetation is not too dense, management interventions are proposed to support natural regeneration.

As part of the Natura Mura project (https://natura-mura.eu/) an experiment with the aim to stimulate the natural regeneration of floodplain forests was conducted by the project partners SiDG, SFS and IRSNC. One of the key issues of the floodplain forests along the Mura is the regeneration, especially of the softwood habitat types present in the immediate vicinity of the

river. The thick layer of herbaceous vegetation in the undergrowth also commonly consisted of fast-growing invasive species such as *Impatiens glandulifera* and *Fallopia japonica*, which compete excessively and thus prevent sprouting and growth of tree seedlings. The hardwood floodplain forest habitat types which occur further inland but are still conditioned by flooding also face various regeneration problems.

The forest grazing method was carried out on two sample plots, one of which targeted the forest habitat type 91E0* on two hectares and the other forest habitat type 91F0 on one ha. In the target area the trees were first logged to make a clearing and allow suitable light conditions for the regeneration of the naturally present tree species. Grazing was carried out using pigs, which is why the area was fenced off.

For the HT91E0* area, the animals were introduced in February and left to graze for a couple of weeks until the target tree species (*Salix alba, Populus nigra,* etc.) would start to release seeds (around mid-April). During this period the pigs would graze the area, opening and mixing the upper layer of soil, thus recreating pioneer soil conditions suitable for the HT91E0* species. After the seeds were released, the animals were removed from the fenced area, which was left to regenerate naturally.

Signs of natural regeneration in the first season after grazing were present, with seedlings appearing in clusters in the area, most notably willows, but also elms. However, in the later part of the season, the herbaceous vegetation would start to overgrow the young seedlings again. We addressed this by performing individual tending of sprouted seedlings by removing the herbaceous competition. We will now observe a long-term dynamic on the plots.

The approach in the area of HT91F0 was similar, with the difference that the animals were moved into the fenced area in late summer, some weeks before the expected release of the oak seeds. The oaks in this area face low regeneration rates which is among other factors also linked with low germination rates of acorn seed. The concept of the method was to leave the animals to graze the area, thus opening the soils, which would in turn create favorable conditions for germination of acorns. The results showed relatively low germination rates; however, this was due to the low acorn yield in the year when the activity was implemented. This factor was difficult to predict and had a major impact of the results as the time frame for implementing the measure was very short.

To summarize, the method has proven to be relatively successful in promoting natural regeneration on HT91E0*. However, one year is insufficient for the young trees to overgrow the herbaceous layer, which can often reach over 2 m in nutrient- and water-rich floodplain forest growing conditions. For HT91F0, the results are somewhat difficult to interpret as success depends directly on the abundance of acorn production. Therefore, a similar method will also be implemented during the LIFE RESTORE for MDD project, where the time frame of the experiment can be longer.

- The development of modern management systems that can make an important contribution to the long-term and balanced development of forests and the management of their ecosystem services for flood protection, water quality and climate change mitigation, while enabling the conservation of biodiversity at the ecosystem, species and genetic levels, is also very important.

In order to harmonize the interests of riparian and floodplain forest users, researchers from the SFI, in collaboration with REFOCuS project partners and stakeholders from across the Mura-Drava-Danube Biosphere Reserve, have produced **a handbook titled "Perspectives for Forest and Conservation Management in Riparian Forests**" DOI: 10.20315/SFS.169). The handbook was published in 2021 in six languages, English, German, Slovenian, Hungarian, Croatian and Serbian, and is freely available to readers at https://www.gozdis.si/publikacije/

- Forest Genetic Monitoring of European black poplar

In order to assess the current status of genetic resources and quantify relevant changes at Forest Genetic Resources in temporal scale and preserve long-term adaptive evolutionary potential, researchers from the SFI, in collaboration with LIFEGENMON project partners from Central and SE Europe, have developed the Manual and Guidelines for Forest Genetic Monitoring (FGM). The Guidelines are primarily intended for personnel conducting fieldwork related to FGM and include detailed instruction on how to carry out regular field observations and measurements for genetic monitoring for seven target tree species and species complexes: *Fagus sylvatica, Abies alba / Abies borisii-regis, Populus nigra, Fraxinus excelsior, Pinus nigra, Prunuis avium, Quercus robur / Quercus petraea.* **Manual and Guidelines for FGM** were published in 2020 in four languages, English, German, Slovenian and Greek, and are freely available to readers at http://www.lifegenmon.si/lifegenmon-manual-for-forest-genetic-monitoring/.

European black poplar naturally forms metapopulations of inter-linked local populations rather than small, isolated populations. To ensure representative sampling across the metapopulation it is important to design a genetic monitoring system with randomly selected monitoring plots of adult trees in local populations, and monitoring plots in their natural regeneration centers along a river system as part of a complete network of interlinked local populations. Genetic identification of trees must be performed by the use of species diagnostic DNA markers. The main obstacle to FGM of European black poplar is finding habitats where the species reproduces effectively, and where conditions support long-term survival of the offspring. **Guidelines for European black poplar FGM** (Bozic et al. 2020) briefly describe European black poplar, its reproduction, environment, and threats, and provide guidance on establishing genetic monitoring plots *in situ* and recording all field level verifiers and background information. For more information see:
http://www.lifegenmon.si/wp-content/uploads/2021/04/FGM_eng_Guidelines_05-Populus.pdf

In the reporting period 2020-2023, four international projects in the field of riparian forests were implemented in Slovenia:

REFOCuS – Resilient riparian forests as ecological corridors in the Mura-Drava-Danube Biosphere Reserve (Interreg The Danube Transnational Programme, 2018-2021)

The riparian forests of the Mura-Drava-Danube Biosphere Reserve, which form ecological corridors, are in poor condition and declining due to increasing incidence of pests & diseases, unsustainable human activities and lack of guidance on how to manage the riparian forests,

including where to find appropriate planting material, so that they can continue to persist and provide all ecosystem services. Forest management measures in the Mura-Drava-Danube Biosphere Reserve vary substantially, ranging from no management through management for nature protection to intensive short-rotation management and monoculture forestry managed for producing quality timber or energy-related biomass. The ecological functions of forests are resilient to certain rates and degrees of disturbance, as forests evolve under the influence of natural disturbances.

The main objective of REFOCuS, to counteract the decline of riparian forests in the MDD BR and beyond, was achieved by meeting two specific objectives: 1) developing new silvicultural methods for forest management and conservation and 2) increasing the availability of suitable forest reproductive material (FRM). The first objective was achieved by developing up-to-date forest cover and biodiversity maps for the MDD, based on which uniform sampling was carried out for the first time to obtain harmonized data for the entire MDD BR. On this basis, new silvicultural methods were defined, bridging the gap between forest management and conservation, and described in a book titled **Perspectives for Forest and Conservation Management in Riparian Forests** (in six languages, DOI: 10.20315/SFS.169). A major contribution to achieving this objective was the development of an information system for identifying and tracking pests and diseases called **DanubeForestHealth** (in six languages, https://danubeforesthealth.eu/) and the training of stakeholders in its use. The main contribution to the second objective was the delineation of transnational seed transfer zones, the description of the procedure for transferring FRM in the region and a web-based tool, Seed4Forest, that allows easy selection of FRM in view of changing conditions due to climate change. A book aimed at helping small nurseries produce FRM of riparian tree species (**Guidelines for the Production of Planting Material for Restoration of Riparian Forests**, https://dirros.openscience.si/IzpisGradiva.php?id=13931) was published and distributed. Gene conservation and potential future needs for different FRM in the region were considered by establishing a gene bank with a living archive in Croatia. Most of the solutions were developed together with stakeholders.

Natura Mura – Restoration of wetland habitats along the Mura River (2020-2023)

In 2019, the Institute of the Republic of Slovenia for Nature Conservation, together with the Ministry of the Environment and Spatial Planning and local communities, concluded the Natura 2000 cohesion project "Restoration of wetland habitats along the Mura", also known as Natura Mura. The project was based on the Action Plan for the Restoration of River and Riparian Habitats in the Natura 2000 Mura Area, created in the previous international coopMDD project. The Institute of the Republic of Slovenia for Nature Conservation as the lead partner of the project has implemented the project together with the Slovenian Water Agency, the Slovenian Forest Service, the Slovenian State Forests, the Municipality of Velika Polana and the Murska Sobota Development Center.

The Natura Mura project, started in March 2020 and lasting until the end of November 2023, was part of the operational program for the implementation of the European Cohesion Policy 2014-2020. The priority axis of the project is a better state of the environment and biodiversity, while the thematic goal is the preservation and protection of the environment and the promotion of efficient use of resources. It represents the implementation of the measures envisaged in the

Natura 2000 Area Management Program. The project area includes two Natura 2000 areas, SPA Mura intended to preserve and achieve a favorable state of bird species and SAC Mura, intended to preserve or achieve a favorable state of plant and animal species and their habitats and habitat types, whose preservation is in the interest of the EU. The area of implementation of the project was the entire Slovenian section of the Mura River.

The current condition of the Natura 2000 Mura floodplains is unfavorable; the consequences of several years of degradation can be seen in the drying up and deterioration of the wetland habitats along the river, where aggressive non-native invasive species and diseases have spread significantly in recent years. The negative consequences of canalization of the river are shown in the deepening of the riverbed and the decline of the groundwater, as well as the inability to create new habitats, since the natural river processes have been stopped. Due to the intensification of use and abandonment of extensive grasslands, the cultural landscape is clearly changing into a unique agricultural landscape.

The entire project was in accordance with relevant regulations, sectoral plans and strategies from the fields of water management, forestry, agriculture, spatial planning and local development. The project was based on the knowledge and experience of already implemented measures on the Mura River and experiences from similar cases of revitalization of rivers and riparian floodplain habitats in Slovenia and elsewhere in central Europe. The project represents a meaningful continuation and upgrade of the activities that were carried out in past revitalization projects on the Mura River.

The project addressed three target habitat types (HT 6510, HT 91E0*, HT 91F0) and 12 target animal species. Restoration of river dynamics and aquatic habitats included the restoration of two oxbow lakes, establishment of a network of ponds in the forest area, and restoration or reconnection of six river side arms. Important measures of renaturation of the Mura riverbed were implemented on the total length of three kilometers in four locations.

In the project 32 hectares of floodplain forests were restored. Invasive non-native tree species and plantations of mature Euro-American poplars were removed and were replaced by suitable for the area typical tree species of habitat types 91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) and Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*). On different locations along the Mura River over 125,000 seedlings of European oak (*Quercus robur*), wild cherry (*Prunus avium*), common hornbeam (*Carpinus betulus*), black alder (*Alnus glutinosa*), white willow (*Salix alba*), European black poplar (*Populus nigra*) and white poplar (*Populus alba*) and others were planted. In the year or two after the project, the locations around the seedlings were mowed due to tall and aggressive undergrowth.

As part of the maintenance and restoration of floodplain forests, the project envisaged the restoration of the HT 91E0* and restoration of the HT 91F0 and implementation of trial measures of natural rejuvenation and restoration of the floodplain forest in the dried alder stand in the Banuta area.

Other activities, such as restoration of 10 ha of wet grasslands on areas that were overgrown by selective removal of overgrowth, was carried out. The most valuable areas of floodplain forests, wetlands for the protection of important parts of the habitats of the Natura 2000 Mura area, were purchased. They will be left to natural processes, without interfering with their structure

and without forest management, which means a permanent improvement of the condition of the habitats along the Mura River. The entire interpretation in the Natura 2000 Mura area, by establishing interpretation polygons, educational trails, playgrounds in nature and information rooms, was implemented.

Figure 1: Murska Suma floodplain forest habitats along the Mura River in Slovenia (Photo: Simon Veberic)

ZaDravo – Drava Natura 2000 River for the future: Improving the conservation status of species and habitat types of the river and river basin of the Drava River (2019-2023)

The Drava – Natura 2000 project started in 2019 and lasted until the end of December 2023. It was part of the operational program for the implementation of the European Cohesion Policy 2014-2020. The project area included two Natura 2000 areas: SPA Drava and SAC Drava. It intended to preserve or achieve a favorable state of target plant and animal species, their habitats and habitat types. The project area was the whole stretch of the Drava River between Maribor and Sredisce ob Dravi.

The current condition of the Natura 2000 Drava floodplains is unfavorable for similar reasons as with the Mura River. In the zaDravo project more than 38 hectares of floodplain forests were acquired by the municipality Sredisce ob Dravi. These forests will act as a non-intervention core zone of the established landscape park and will be subject to natural processes. Additionally, 16.5 hectares of floodplain forests were restored. In the restoration process 12 hectares were replanted with typical tree species of habitat types HT 91E0* Alluvial forests

with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)" and HT 91F0 Riparian mixed forests of *Quercus robur, Ulmus laevis* and *Ulmus minor, Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*). Measures for natural rejuvenation were tested and implemented on 4.5 hectares of floodplain forests.

LIFE RESTORE for MDD – Preserving and restoring floodplain forest habitats along the Mura-Drava-Danube Rivers (2023–2028)

In October 2023 the LIFE RESTORE for MDD project began. The project is a cooperation initiative between Austria, Slovenia, Croatia, Hungary and Serbia, which focuses on the preservation and restoration of floodplain forests along the Mura, Drava and Danube rivers. The Slovenian partners of the project are the IRSNC, SiDG and Slovenian Water Agency. The main objective of the project is to preserve and improve key ecosystems, with the focus on two forest habitat types 91F0 and 91E0* in the UNESCO five-country Mura-Drava-Danube Biosphere Reserve, which includes seventeen Natura 2000 sites and other protected areas. In Slovenia it will be implemented in the Natura 2000 site Mura and the Mura River Biosphere Reserve. By restoring natural and dynamic hydro-morphological processes to mobilize sediments and create pioneer habitats, improving lateral connectivity, preserving different habitat structures and floodplain function, improving and preserving key habitat structures in floodplain forests and, last but not least, establishing cross-sectoral and cross-border planning for restoration, some of the main pressures on floodplain forests can be tackled.

Project activities in Slovenia follow the conservation goals and measures defined in the Natura 2000 Area Management Program and are planned based on the Action Plan for Restoration of River and Riparian Habitats in the Natura 2000 Mura Area. Floodplain forests along the Mura River will be restored on 20 hectares by conversion of non-native poplar tree/plantations with native tree species such as *Populus nigra, Salix alba, Quercus robur*, etc. The main aim of this activity is to improve the state of the priority floodplain forest habitat type 91E0* and 91F0. Additionally, genetic and planting material of two native tree species, *Ulmus leavis* and *Fraxinus angustifolia*, will be provided, as the two species are under the pressure of different diseases.

We will improve the hydro-morphological conditions of the floodplain forests through the renaturation of the Mura riverbed in three sections. Moreover, one side arm and one oxbow lake will be restored. Twenty hectares of private forests will be purchased, which will be permanently dedicated to nature protection. An important part of the project will be to prepare a proposal for the establishment of protected areas along the Mura River in Slovenia.

d) Agroforestry and Trees Outside Forests with emphasis on their effects on forest and agricultural crops or livestock and diversification of the landscape

SFI coordinates the project financed by the European Agricultural Fund for Rural Development (http://ec.europa.eu/agriculture/rural-development-2014-2020/index_sl.htm) and the Rural Development Program of the Republic of Slovenia (www.program-podezelja.si/) dealing with out of forest hedges in agricultural land with significantly reduced biodiversity. The project aims are to encourage the recognition of their ecological and economic importance by removing atypical species (including mainly invasive and non-native species) and to restore the hedges by reintroducing typical flora and fauna species with greater production and a functional role

for preserving the traditional and disappearing cultural pattern of the Slovenian countryside and providing ecosystem services. At the end of last year, *Corylus avellana* seedlings whose root systems were infected with black truffle spores were planted on five farms. The first results are expected to be available in the coming years.

5. Environmental and Ecosystem Services

- **Phyto-remediation of polluted soil and water**

Wastewater treatment plants based on short-rotation *S. alba* clones were investigated in terms of biomass production and fate of macronutrients and metals (Istenic and Bozic, 2021). The *S. alba* clone 'V 052' (*S. alba* L. var. *calva* G.F.W. Mey × *S. alba* L.) produced more biomass and had higher nitrogen and phosphorous uptake compared to 'V 093' (*S. alba* L. × *S. alba* var. *vitellina* (L.) Stokes) × *S. alba* L.) and 'V 160' (*S. alba* L.). Nitrogen and phosphorus uptake into the harvestable woody biomass was significantly higher in all clones studied compared to other plant-based wastewater treatment plants, indicating the nutrient recovery potential of evapotranspirative willow systems. The composition and load of the wastewater matched the nutrient requirements of the willows.

Figure 2: Pilot evapotranspirative willow system for treatment of municipal wastewater in Ajdovscina, Slovenia (Photo: Darja Istenic)

Next, a state-of-the-art review in short rotation coppice to treat various industrial and municipal effluent showed that such a system can produce valuable biomass in an economic and sustainable way, showing potential in the field of pollution control and a bio-based circular economy (Hänel et al., 2022). The review showed that the most applied and studied tree species in such systems are willows (32%), followed by eucalyptus (21%) and poplars (18%). Most of

the reviewed studies used domestic wastewater (85%), followed by industrial wastewater (8%) and landfill leachate (7%). Most data show high BOD_5 and COD removal efficiencies (80%). There are large differences in the documented total nitrogen and total phosphorus removal efficiencies (12%–99% and 40%–80%, respectively).

We have represented, explained and promoted zero-discharge evapotranspirative willow systems as a nature-based wastewater treatment plant in various scientific communities. The working group "Sanitation for and by nature" co-led by the International Water Association (IWA), The Nature Conservancy (TNC) and Science for Nature and People Partnership (SNAPP) published a series of fact sheets and case studies "Nature-based solutions for wastewater treatment", in which Darja Istenic, University of Ljubljana, co-authored a fact sheet on evapotranspirative willow systems. In addition, evapotranspirative willow systems are part of a decision support system for the selection of nature-based solutions for domestic wastewater treatment developed by ICRA, Spain (https://snapp.icra.cat/) (Acuňa et al., 2023). Evapotranspirative willow systems have also been presented as nature-based building blocks for resource recovery systems in cities (Van Hullenbusch et al., 2021) and included in a review of nature-based solutions for resource recovery in cities (Kisser et al., 2020) as part of the COST Action Circular City Re.Solution CA17133.

The University of Ljubljana, Faculty of Civil and Geodetic Engineering, supports the Ljubljana waterworks and sewerage public utility company (JP VOKA-SNAGA) in the management of stormwater runoff using nature-based solutions. As part of the Interreg Central Europe project MAURICE – Management of urban water resources in Central Europe facing climate change, JP VOKA-SNAGA aims to reduce the risks of flooding from combined sewer overflows through advanced infiltration of rainwater in the city. An overview map of infiltration solutions for different soil permeabilities and groundwater qualities will be created including systems based on short-rotation willows.

III. GENERAL INFORMATION

1. Administration and Operation of the National Poplar Commission or equivalent Organization

On 25 May 2000, the Republic of Slovenia became a party to the Agreement establishing the International Poplar Commission (IPC) within the FAO. In response to the invitation of the IPC Secretary on 18 December 2013, the Scientific Board of the Slovenian Forestry Institute appointed Dr. Gregor Bozic as representative of the National Poplar Commission of Slovenia on 20 December 2013.

The National Poplar Commission is the framework for official cooperation, the promotion and exchange of ideas and materials between IPC, researchers, conservation experts, stakeholders, forest nurseries managers, and landowners. Since October 2022, Dr. Darja Istenic, University of Ljubljana, Slovenia, has been an IUFRO office holder as Deputy Coordinator of Unit 1.06.01 Phytotechnologies for degraded sites in rural and urban communities. The Unit has proposed a joint technical session "Fast-Growing Trees for a Greener Future: Global Applications of Nature-Based Solutions" for the IUFRO World Congress 2024, to be held in Stockholm in June 2024. The technical session was accepted in April 2023 and is listed under session number T2.8.

Darja Istenič et al. submitted an abstract "Potential of short rotation willow systems for water treatment", which was accepted for oral presentation in session T2.8. She will also chair a poster session 2 as part of session T2.8.

The National Poplar Commission has supported the international initiative for a re-assessment of risks posed by the planned hydropower projects in the Vjosa basin prepared by Prof. Fritz Schiemer (Austria) and Prof. Aleko Miho (Albania). The petition was signed by almost 800 scientists from all over the world. On the 15th of March 2023, the Vjosa River in Albania was declared the first European Wild River National Park. The full length of the Vjosa in Albania, from the Greek border to the Adriatic Sea including its main tributaries, is protected as an IUCN cat II national park, in total more than 400 kilometers of rivers and streams. The originally planned 45 hydropower plants in the river system will not be built. This is a unique achievement and we believe this concept of a wild rivers national park could become a blueprint for large scale river protection in the region as well as in the whole of Europe. https://www.theguardian.com/environment/2023/mar/15/albania-vjosa-wild-river-national-park-europe-first-aoe

2. Literature

Publications on poplars, willows, and other fast-growing trees issued in the period under review (2020-2023) including technical papers presented at meetings, congresses, etc.

Poplars and willows

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Other fast-growing tree species: black locust and black walnut

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3. Relations with other countries

The main cooperation in the reporting period was carried out between the Slovenian Forestry Institute and research institutions, universities and nurseries in Croatia, Austria, Hungary, Albania, Serbia and the USA.

IV. SUMMARY STATISTICS (Questionnaire)

The questionnaire contains data on poplars, willows, and other fast-growing trees in Slovenia and summarizes the statistics of key parameters in poplars, willows, black locust and black walnut resources, production, utilization, trade, and future trends. It is completed with data according to the Forest Information System of the SFS corrected by field information from regional offices of the SFS and the SiDG gathered in 2023. The total area is calculated based on forest stands where the growing stock of the analyzed tree species is equal to or higher than 1 m^3 while the

production area is divided according to the wood removals structure. Data for the total removals are based on the data on the amount of felling (m^3) collected by the SFS in the year 2023.

Slovenia does not collect data on roundwood production at the tree species level (but only on the level of coniferous/non-coniferous trees). Therefore, data on the use of wood are partially based on the wood processing industry's information and partially on expert assessment.

The country report of the National Poplar Commission is based primarily on the specialized contributions of the following individuals and institutes:

Slovenian Forestry Institute (SFI)
Vecna pot 2
SI-1000 Ljubljana, Slovenia
http://en.gozdis.si/

Institute of the Republic of Slovenia for Nature Conservation (IRSNC)
Regional Unit Maribor
Pobreška cesta 20
SI-2000 Maribor, Slovenia
http://www.zrsvn.si

University of Ljubljana
Faculty for Health Sciences
Zdravstvena pot 5
SI-1000 Ljubljana, Slovenia
https://www.zf.uni-lj.si/en/

Research Center of the Slovenian Academy of Sciences and Arts
Institute of Biology
Novi trg 2
SI-1000 Ljubljana, Slovenia
https://bijh.zrc-sazu.si/en

Slovenia Forest Service (SFS)
Vecna pot 2
SI-1000 Ljubljana, Slovenia
http://www.zgs.si/eng/homepage/index.html

Slovenia State Forestry Company (SiDG)
Rozna ulica 39
SI-1330 Kocevje, Slovenia
http://www.sidg.si

Ministry of Agriculture, Forestry and Food
Forestry and Hunting Directorate
Dunajska cesta 22
SI-1000 Ljubljana, Slovenia
https://www.gov.si/en/state-authorities/ministries/ministry-of-agriculture-forestry-and-food/

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Contributors:
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