APPLAUSE

- FROM HARMFUL TO USEFUL WITH CITIZENS' LED ACTIVITIES

LESSONS LEARNED



RECOGNIZE, REUSE OR HAND OVER.

Edited by: Zala Strojin Božič, M.Sc.

The project partners participated in the creation of this text. Photographs, maps and schemes: Nataša Ilec, Jutra Černilogar, Urša Kanjir, Mateja Kavčič, Petra Sladek, Simona Strgulc Krajšek, Maks Merela, Rybkin Iaroslav, Zala Strojin Božič, Matjaž Tančič, Branka Trčak, Viljem Vek, Darja Virjent Translation: K&J Translations Design: Yootree d. o. o. Publisher: The City of Ljubljana, Department for Environmental Protection, Zarnikova 3, Ljubljana, 2020 Print: Trajanus, d. o. o. Circulation: 375

The publication is free of charge. This paper was produced locally from invasive alien plants.



The APPLAUSE project is co-financed by the European Regional Development Fund through the Urban Innovative Actions (UIA) initiative. The information and standpoints exclusively reflect the authors' views. The UIA initiative shall not be liable for them nor for their use.

INTRODUCTION

SPECIES INTRODUCED BY HUMANS INTO AN ENVIRONMENT IN WHICH THEY DID NOT THRIVE BEFORE ARE CALLED ALIEN SPECIES.

They come to our places in different ways, and many have been settled by man deliberately in order to bring benefit, e.g. edible plants (such as potatoes, tomatoes and maize), fodder and honey plants, ornamentals, shrubs and trees. These contribute to the well-being of people, and we can hardly imagine our lives without them. Among them are also plants that have been introduced into an environment unintentionally. Most alien species do not survive in the new environment because they cannot adapt to it, and only a few are able to settle, successfully reproduce, spread and with time cause damage to the conquered area. We call them invasive alien species.

Invasive alien plant species (IAPS) have been recognized for several decades as one of the most important reasons for the decline of biodiversity. They can also cause economic and environmental damage, some are even harmful to human health, as they can cause allergies, skin reactions and inflammation. Like other cities, Ljubljana also faces the problem of IAPS spreading. Since 2014, we are implementing the socially responsible campaign Gloves Up!, which is intended to educate citizens about the harmfulness of IAPS. Citizens' participation is also a basic building block of the EU APPLAUSE project, in which we have focused on development of new tools for identifying IAPS, education and research of the potential for processing IAPS into various raw materials and products.



Himalayan balsam.

APPLAUSE PROJECT

The project addresses unsolved questions with regard to IAPS in terms of the zero-waste approach and circular economy. At present, we are composting or incinerating these plants, and with the pilot project for processing plants into paper at a semi-industrial level, we have already proven that they can be reprocessed for other useful purposes.

The APPLAUSE project builds on:

• raising awareness and cooperation with citizens on the identification, collection and reuse of IAPS for various purposes through a number of activities;

- development of new tools for the identification and inventory of IAPS through aerial (orthophoto) and satellite imagery analysis and the establishment of a public information platform for the identification and management of IAPS;
- analysis of biomass suitability and development of new products from IAPS. Parts of the plant are used as raw material for paper and wood products, food, dyes and hybrid coatings, and pest control;
- introduction of new, unconventional processes and techniques for the production of paper and thin layers from IAPS using enzymes and the use of residues in paper production;
- testing the concept of using black (waste) liquid in the production of paper that can be processed into raw materials for industrial purposes, e.g. vanillin derivatives, which are an intermediate product in the production of pharmaceuticals, cosmetics and other fine chemicals, as well as polymers for the storage of microorganisms;
- identification of IAPS as the origin of industrially important microbial strains for delignification, cellulose conversion, biofuel production, etc.;
- processing wood residues into fully recyclable 3D wood-plastic composites (e.g. boards and cutlery), liquefied wood and coatings;
- pilot nanocellulose products from IAPS.

The proposed system of managing IAPS in the City of Ljubljana is based on education and cooperation with the citizens of Ljubljana and three principles of operation:

- 1. "Do it yourself",
- 2. "Let's do it together" and
- 3. "Hand over"

PUBLIC PARTICIPATION



System of managing IAPS in the City of Ljubljana.

THE APPLAUSE PROJECT FOCUSES ON 25 IAPS; 17 ARE WOODY AND 8 ARE HERBACEOUS SPECIES.

- 1. box elder (*Acer negundo*), Foto: Branka Trčak
- 2. horse chestnut (Aesculus hippocastanum), Foto: Branka Trčak
- 3. tree of heaven (Ailanthus altissima), Foto: Simona Strgulc Krajšek
- 4. false indigo bush (Amorpha fruticosa), Foto: Branka Trčak
- Thunberg's barberry (Berberis thunbergii), Foto: Simona Strgulc Krajšek
- David`s butterfly bush (Buddleja davidii), Foto: Simona Strgulc Krajšek













- southern catalpa (Catalpa bignonioides),
 Foto: Branka Trčak
- 8. red osier dogwood (Cornus sericea), Foto: Branka Trčak
- 9. wall cotoneaster (Cotoneaster horizontalis), Foto: Petra Sladek
- **10.** stinkwort (*Dittrichia graveolens*), Foto: Simona Strgulc Krajšek
- 11. Japanese knotweed (Fallopia japonica), Foto: Branka Trčak

- 12. Bohemian knotweed (Fallopia × bohemica), Foto: Simona Strgulc Krajšek
- **13.** honey locust (*Gleditsia triacanthos*), Foto: Petra Sladek
- 14. Jerusalem artichoke (Helianthus tuberosus), Foto: Simona Strgulc Krajšek
- Himalayan balsam (Impatiens glandulifera), Foto: Simona Strgulc Krajšek



- 16. Amur honeysuckle (Lonicera maackii), Foto: Simona Strgulc Krajšek
- **17.** Oregon grape (Mahonia aquifolium), Foto: Simona Strgulc Krajšek
- cherry plum (Prunus cerasifera), Foto: Simona Strgulc Krajšek
- **19. cherry laurel** (*Prunus laurocerasus*), Foto: Branka Trčak
- **20. staghorn sumac** (*Rhus typhina*), Foto: Simona Strgulc Krajšek
- **21. black locust** (*Robinia pseudacacia*), Foto: Branka Trčak

- 22. cutleaf coneflower (Rudbeckia laciniata), Foto: Simona Strgulc Krajšek
- 23. Canadian goldenrod (Solidago canadensis), Foto: Branka Trčak
- 24. giant goldenrod (Solidago gigantea), Foto: Branka Trčak
- **25. Japanese spiraea** (*Spiraea japonica*), Foto: Branka Trčak



LESSONS LEARNED THERE IS NO SUCCESS WITHOUT COOPERATION

Diversity is an opportunity that encourages creative thinking and helps to implement better and more innovative solutions. This is especially important in the field of the circular economy, where we are building value chains. The members of the chain are partners who, in most cases, come from different fields of work and use different methods of work in carrying out their tasks. The role and responsibility map is therefore a necessity with which we later avoid misunderstandings and excuses. A professional moderator who is not involved in the partnership can also help solve major stagnations.

In the circular economy, more attention should be paid to partners with fewer employees. Administrative work, which can be too extensive for small organizations (2–3 employees), can be assigned to a temporary administrator, allowing professionals to better focus on the content.

Forming partnerships is a process that requires sufficient time. There are several forms of partnerships, from very formal ones (signing a contract) to completely informal (also more flexible). When working together, the most important thing is that the partners agree on the purpose and objectives of the work.

In the development of circular business models, not only the economic aspect of cooperation is important, but also the environmental and social.

APPLAUSE PROJECT BENEFITS

Number of participants in the project: 16 organizations, a total of 185 people

HOW TO INCLUDE THE CITIZENS?

The method of achieving the full participation of citizens in decision-making and activities is called the participatory model. This approach represents a vision of democratic, community-oriented participation of all individuals. For successful cooperation with citizens, the first and key step is to establish a relationship. From the point of view of cooperation, we can distinguish three milestones: the decision to participate, the initial participation and the permanent participation. The three main factors that usually influence the decision to participate are: users need to be aware of the opportunity, users need to recognize the appropriateness of the opportunity and users need to be motivated.

CONTACT

- City of Ljubljana, Office for Development Projects and Investments, Section for Development Projects, Adamič-Lundrovo nabrežje 2, 1000 Ljubljana
 Tanja Geršak, M.Sc., applause@ljubljana.si
- City of Ljubljana, Department for Environmental Protection, Zarnikova 3, 1000 Ljubljana
 Zala Strojin Božič, M.Sc., applause@ljubljana.si

APPLAUSE IDEAS	THE MOTIVE FOR COOPERATION: • users participate in voluntary actions • values, environment-protection • engaged owners of private IAPS surfaces • legislation • land value / potential damage THINK ABOUT POSSIBLE BARRIERS TO PARTICIPATION AND HOW TO OVERCOME THEM • unconsciousness, disinterest DEVELOP A PLAN FOR MONITORING AND CONTROLLING ACTIVITIES • records (collection center, attendance sheets)	RECORDS ALREADY IN PLACE PROVIDE AN OPTION FOR CUSTOM SERVICE OF IAPS DISPOSAL AND BIOMASS TAKEOVER
OPPORTUNITY AWARENESS AND THE DECISION TO PARTICIPATE	CREATE AWARENESS OF THE OPPORTUNITY OF THE APPLAUSE PROJECT PR communication/information on how the user can participate DIFFERENT AUDIENCES AND COMMUNICATION 14 (active, elderly, young): Invitation to 1APS voluntary actions, visit educational workshop • owners: provide information for identification and efficient disposal, invitation to submit IAPS biomass to the Collection center CLEARLY PRESENT THE PURPOSE OF THE PROJECT, WHAT ARE THE TASKS OR OPPORTUNITIES FOR PUBLIC PARTICIPATION AND WHERE THEY CAN GET MORE INFORMATION OR PRACTICAL GUIDANCE	WEB PACE - information and practical guidance COOPERATION WITH TRŠH, ARTEMIS, NATURA 2000, WITH ECOLOGICALLY CONSCIOUS ASSOCIATIONS, GARDENING CENTERS - attracting engaged users for cooperation COLLECTION CENTER INSTRUCTIONS FOR USERS
FIRST PARTICIPATION	TO ENSURE THAT THE EXPECTATIONS AND TASKS OF PARTICIPATING USERS ARE UNAMBIGUOUS AND CONSISTENT TO DETERMINE REWARDS FOR FIRST ATTENDANCE IDENTIFY THE REASONS WHY THE PARTICIPANT IS ATTRACTED TO PARTICIPATION (PERSONAL VALUES, NEW KNOWLEDGE)	INSTRUCTIONS FOR USERS WHO REMOVE IAPS (Announcement / higher volumes / possible material for products) PERSONAL ADMISSION OF USERS TO COLLECTION CENTER AND BIOMASS TAKEOVER
CONTINUOUS	TO ENSURE THAT THE PROJECT IS WELL ORGANIZED AND THAT COMMUNICATION WITH USERS IS REGULAR GIVE USERS FEEDBACK THAT THEIR PRESENCE AND TIME SPENT ARE VALUABLE EXPLORE HOW ENGAGED USERS CAN BE REWARDED DEFINE THE TYPE OF REWARDS	COLLECT USER DATA WITH CONSENT (first and last name, email) FOR THE PURPOSE TO BUILD A COMMUNITY INFORMING AND GIVING FEEDBACK
AFTER THE PARTICIPATION	ESTABLISH TOOLS SO THAT PARTICIPANTS CAN PROVIDE FEEDBACK	QUESTIONNAIRES IN PHYSICAL FORM
		"SUGGESTIONS, COMMENTS" AS A SECTION OF THE WEBSITE AND THE POSSIBILITY OF COMMUNICATION THROUGH THE EMAIL APPLAUSE@LJUBLJANA.SI
IAPS - Invasive ali plant species	en - activities that could be - implemented in	activities already mplemented

AWARENESS RAISING

Citizens' education is a process as well, with the results not being visible immediately, but showing up in the long run. Identifying and eradicating IAPS must become a habit, and a variety of activities is required to carry them out. In most cases, those activities that are easy and fun for the participants are more successful. Experience shows that the use of short films, e.g. on YouTube, 3D models, culinary workshops and phone apps are the most popular.

Information provided must be unambiguous and professionally verified. It is recommended to use different communication channels, for young social networks, for older population publications. Festivals of (re)use, where various products are on display and the public has the opportunity to ask questions directly, work very well too. Experience shows that some elderly residents with physical disabilities are less motivated to acquire knowledge about the IAPS eradication. However, school children proved to be the most appropriate age group in terms of activities organization, performance and acceptance of knowledge.



APPLAUSE PROJECT BENEFITS

Number of educational workshops carried out and number of participants: 143 workshops, 2,980 participants

Number of educational events (excluding workshops): 29

Number of educational films (YouTube): 44

Number of publications: 12

Number of exhibitions: 2

HOW TO INVOLVE CHILDREN?

The workshop for children is carried out in two parts. The first part is intended to present the issue of IAPS. If no IAPS grow nearby, use photographs, 3D plant models or short films. The first part of the workshop should last up to 45 minutes. The second part of the workshop is experiential. Children get to know the process of making paper (machine or hand-made) and wood products, they can also learn the traditional technique of high letterpress printing. The second part of the workshop should last a maximum of 1.5 hours. At the end of each workshop, the children fill in a short questionnaire (up to 5 questions).



Workshop on hand paper production for children.

CONTACT

 City of Ljubljana, Department for Environmental Protection, Zarnikova 3, 1000 Ljubljana Branka Trčak, applause@ljubljana.si

IAPS WIDESPREADNESS

IAPS have been present in Slovenia for several decades. Some occur in populations that can still be permanently eradicated, some unfortunately no longer. In order to make the right decisions, we need to know their widespreadness.

For IAPS widespreadness analysis, we can use new, innovative methods, such as the analysis of aerial and satellite images. Unfortunately, the two methods are not without drawbacks, as the final result depends mainly on the properties of the original images (appropriate time series of field data), the density of the plant species and the size of the location. In urban areas, we often have smaller degraded areas where invasive alien species grow mixed and it is impossible to identify an individual plant species from satellite images. It is also important that field data are obtained for the whole research area and not just for a part of the area. The spatial distribution of terrain data leads to greater homogeneity of the sample data and leads to better detection results throughout the investigation area.

In plant identification, we can also use applications based on the deep learning approach – today the most well-known and widely used is artificial intelligence (AI) approach. There are still many unknowns in understanding the operation of recognition based on deep learning, so it is extremely important what method of recognition we choose (whole plant, individual parts, combination of parts included) and how we design the learning set. In any case, it is necessary to get acquainted with how the experts carry out field inventories.

Data are the capital of the future. More and more of them are being published in open form. The choice of appropriate data management platform is thus a very important decision, as it affects maintenance costs, the quantity and quality of analyses and the possibilities for data exchange.

APPLAUSE PROJECT GAINS

Number of newly obtained pieces of IAPS data: more than 26,000 data for 120 plant species at approximately 17,000 localities (growth sites). The area of the growing sites covers over 2.3 km².

Saved time by using a new IAPS management platform: Example of common ragweed eradication (350 locations). We estimated that it took 24.9 hours to manually prepare a list of locations and eradication maps before setting up the platform, now we need 11.6 hours to do the same work.

HOW DO WE OBTAIN DATA?

The distribution of plants in the environment is monitored mainly through field inventories. Field inventory data are collected using an information system on a tablet computer. The system allows experts to use a tablet to draw areas of found IAPS, attach their photographs and enter characteristics such as the size and density of the population and the height. The app also allows to plan measures such as harvesting or processing into products. Filed inventory results are available as open data.



Display of filed inventory results with an application for the inventory of invasive alien plants.

Since the implementation of field inventories is time consuming and costly, we can use an automatic algorithm to detect IAPS from aerial (orthophoto) images or from optical satellite images (e.g. optical satellite images Sentinel-2). The final results of these algorithms are widespread models, which are supposed to show us the state and extent of the occurrence of IAPS in a certain geographical territory, in our case in the area of the City of Ljubljana.



LEGENDA:

- City of Ljubljana
- Japanese knotweed

 Locations of invasive alien knotweed, detected by analysis of an aerial (orthophoto) image.

CONTACT

• Analysis of orthophotos and satellite images: Slovenian Centre of Excellence for Space Sciences and Technologies Space-SI, Aškerčeva cesta 12, 1000 Ljubljana

Urša Kanjir, ursa.kanjir@space.si

• Data management platforms: GDi, d. o. o., Ljubljana, Šmartinska cesta 106, 1000 Ljubljana

Mateja Kavčič, M.Sc., mateja.kavcic@gdi.net

• Field inventory: City of Ljubljana, Department for Environmental Protection, Zarnikova 3, 1000 Ljubljana

Branka Trčak, applause@ljubljana.si

 Field inventory: University of Ljubljana, Biotechnical Faculty, Department of Biology, Večna pot 111, 1000 Ljubljana

Simona Strgulc Krajšek, Ph.D., simona.strgulc@bf.uni-lj.si

PLANT HARVESTING

In Ljubljana, trees in public areas are not cut down unless they dry out, are infected or endanger passers-by or infrastructure. The input material for processing is therefore not of very high quality, but there is a lot of waste that can be used for making 3D composites. Many of the removed trees are small in size and therefore not useful for the production of wooden planks. Cut shrub branches can be used for small wooden products.

Harvesting invasive herbaceous plants for processing requires a lot of work and endurance (e.g. manual harvesting of flowers, leaves, rhizomes). The works are carried out seasonally, they also depend on the weather. Some plant material is not available all year round. For processing purposes, it is important to have a special place for drying plant material and a dark, cold and dry storage place. If there is too much material, it can mold. Stocking woody parts is not recommended as it can be attacked by molds and pests. Primary wood treatment (wood cutting) of trees from urban environments requires a special approach. Trees in urban environments often contain small items, e.g. nails, screws that can damage the saw. When the dried plant material is grounded, use a breathing mask.

When harvesting IAPS, it is very important that the work is carried out professionally and with appropriate equipment. In the case of the implementation of voluntary harvest activities, we most often face the following challenges: how to motivate participants to devote their free time to harvesting activities, how to provide a large enough group of volunteers and weather. A very rewarding target group for voluntary harvesting campaigns are high school and forestry students. By participating in such activities, they gain valuable experience, which can help them to make better decisions in later professional life.

APPLAUSE PROJECT BENEFITS

Amount of biomass harvested: 60 m³ of wood and 13 tons of herbaceous plants

Number of new protocols for IAPS removal: 2

Number of voluntary harvesting actions and participants: 28 harvesting actions, 490 participants

HOW TO ACT ON YOUR LAND?

If you find an invasive alien plant on your land, look for additional information about it. It is very useful to know whether the plant is propagated by seeds or also by underground parts (rhizomes, tubers). Try also to find information on whether the plant is toxic or allergenic, as in

this case you must use personal protective equipment during its removal. For example, gloves should be used to remove common ragweed, and protective clothing, gloves and goggles should be worn in case of a giant hogweed eradication. If the plant is allergenic, it is better to remove it before it blooms. If it spreads by seeds, remove it during or before flowering. All IAPS must be removed as soon as possible. This saves you effort and costs. After a few years, complete eradication may no longer be possible, as the plant will spread not only across your land but also to other promises. In case of overspread, continue to limit the growth with mowing or other suitable measure.

CONTACT

 Herbaceous plants harvesting: VOKA SNAGA, water and waste management public company, Vodovodna cesta 90, 1000 Ljubljana

Meta Vidovič, meta.vidovic@vokasnaga.si

• Organization of voluntary harvesting actions: City of Ljubljana, Department for Environmental Protection, Zarnikova 3, 1000 Ljubljana

Branka Trčak, applause@ljubljana.si

 Wooden plants harvesting: TISA, Company for arboriculture and forestry, Cesta v Prod 84, 1000 Ljubljana

Lena Marion, lena.marion@tisa.si



"DO IT YOURSELF" RULES





Do it yourself (DIY) is a way of making, changing or repairing things without direct assistance from experts. Approaches arise from a variety of motivations that allow people to achieve greater self-sufficiency and autonomy in a market-oriented economy. Such communities typically create according to open source principles that allow free access to production plans, exchange of skills and knowledge, and continuous product improvement. It is also necessary to create an environment where recipes/instructions can be circulated and upgraded.

Do-it-yourself culture is becoming increasingly popular in Slovenia as well. When preparing the instructions, you must specify very precisely the parts of the plants needed, the quantity, the period of harvesting and the necessary tools. It is also useful to indicate the approximate production time (minutes or hours), the level of complexity (with warnings regarding the use of hazardous substances) and the handling of waste material. From sustainability and circularity point of view, guidance on the recommended way of using the product and handling the product after its life is also welcomed.

APPLAUSE PROJECT GAINS

Number of DIY plans and recipes: 26

Number of DIY films: 8 films about product (maximum number of views: nesting box with a green roof – 16,000 views) and 7 culinary recipes (maximum number of views: Smoothie made of cherry plum – 35,500 views).



(from top to bottom)
 Floral letter
 Seed paper
 Paper pot for plants
 Sieve and frame for handmade paper production

HOW TO START?

Include as many citizens as possible to the processing of IAPS into useful products. Within the APPLAUSE project we have prepared a DIY catalogue, which contains plans for the production of:

- dyes from Japanese knotweed extracts
- eco-bag painted with staghorn sumac dye

sieve and frame for

handmade paper

- dyes from staghorn sumac extracts
- seed paper
- paper pot for plants
- floral letter

- nesting box with a green roof
- serving board
- xylophone

You can order it free of charge at the e-mail address applause@ ljubljana.si or download it on the website of the City of Ljubljana (Slovene only).









(from top to bottom) Serving board Xylophone Picture frame Nesting box with a green roof

CONTACT

 Design of DIY wood and paper products: TRAJNA, association for the development of sustainable design, Dunajska cesta 56, 1000 Ljubljana

Gaja Mežnarić Osole, info@trajna.si Andrej Koruza, info@trajna.si

 Food recipes for Jerusalem artichoke and cherry plum: National Institute of Chemistry, Department of Food Chemistry, Hajdrihova 19, 1000 Ljubljana

Irena Vovk, Ph.D., irena.vovk@ki.si Vesna Glavnik, Ph.D., vesna.glavnik@ki.si Jana Stanič, jana.stanic@ki.si

 Pest control: University of Ljubljana, Biotechnical Faculty, Department of Agronomy, Jamnikarjeva 101, 1000 Ljubljana

Tanja Bohinc, Ph.D., tanja.bohinc@bf.uni-lj.si Stanislav Trdan, Ph.D., stanislav.trdan@bf.uni-lj.si

 Preparation of dyes: University of Ljubljana, Faculty of Chemistry and Chemical Technology, Department of Chemistry and Biochemistry, Večna pot 113, 1000 Ljubljana

Jernej Iskra, Ph.D., jernej.iskra@fkkt.uni-lj.si Monika Horvat, monika.horvat@fkkt.uni-lj.si

 Preparation of dyes and dyeing of textiles: University of Ljubljana, Faculty of Natural Sciences and Engineering, Department of Textiles, Graphic Arts and Design, Aškerčeva cesta 12, 1000 Ljubljana

Marija Gorjanc, Ph.D., marija.gorjanc@ntf.uni-lj.si

LET'S DO IT TOGETHER

You can process harvested IAPS biomass by yourself, or you can set up different workshops where you can process it together with the professionals.

Within the APPLAUSE project, we use machine-made or hand-made paper made from Japanese and Bohemian knotweed, Canadian and giant goldenrod or black locust. Based on laboratory and pilot tests, machine-made paper from IAPS is suitable for analog printing technologies such as off-set, flexo and letterpress, and digital printing technologies (electrophotography) and partly for office printing with ink. The best diverse prints, regardless of the printing technique, were achieved on paper from a goldenrod. Some caution is needed when using inkjet printers due to absorption of ink into the structure, when cutting (laser cutting works best) and laminating (store paper in a room for a few days before laminating).

Hand-made paper has a more pronounced structure than machine-made paper and is a boutique product in itself. The traditional way of making paper is carried out on older machines and devices, according to a recipe from the Middle Ages. Care should be taken when choosing the type of printing (screen printing works best), it also works very well when drawing watercolors. In addition to paper sheets, we can also make 3D products from paper pulp, for which we can develop innovative tools such as machine for pressing plant pots and shaping paper bricks.

The most suitable woods for wooden products production are tree of heaven, horse chestnut, box elder and above all black locust, which is also suitable for outdoor products. Staghorn sumac, honey locust and cherry plum also have very decorative and colorful textures.

When printing posters with letterpress printing, we use large wooden letters. Traditionally, wooden letters are made of pear wood, but we have proven that box elder also works great. The technique of letterpress printing has received considerable attention in the last decade. It is being rediscovered by artists and graphic designers and is increasingly involved in the educational process in schools and art academies.

APPLAUSE PROJECT BENEFITS

Number of reused machines: 12

Number of people trained to make hand-made paper: 2

Quantity of paper produced: 7,200 kg

Wood products designed and produced: box with stamps, picture frame, frame and sieve for handmade paper production, bookcase, dining table, desk, wardrobe, footstool, composter, xylophone, nesting box, Christmas tree, serving board, mobile kitchen, box for storage, wooden mat, shoehorn, wooden pointer, wooden Christmas decorations, wooden pebbles, bottle holder, didactic tools for schools and bag carrying holder Paper products designed and produced: paper brick, Collection of Travelling Plants, Forager's Calendar, floral letter, pots for planting plants, paper decorations, Memory game, puzzle with the motif of Old Ljubljana and DIY paper basket

WHERE TO FIND US IN LJUBLJANA?

JP VOKA SNAGA carries out educational and creative workshops on paper and wood processing at Povšetova ulica 6 with the aim of spreading basic knowledge about paper, wood and the 'do it yourself' culture. Workshops offer a sustainable solution to how we can handle IAPS in the future. Workshops include programs for groups or individuals (science and technology days for children from the age of six, rental of a hand-made paper workshop with a master), tailored to the participants wishes.

In the premises of the Pulp and Paper Institute at Bogišićeva 8, where you can join educational workshops with a tour of the pilot paper machine. The purpose of the workshops is to demonstrate the basics of papermaking for groups or individuals. We offer a creative day for children up to the age of six, a technical day for primary and secondary school pupils, and a workshop on the topic of using paper in everyday life. We also prepare workshops according to the wishes of the participants.

At Breg 22, in the tipoRenesansa studio, where we carry out workshops for making posters with wooden letters for letterpress printing. The purpose of the workshops is to learn the old printing technique and make a poster through a creative game with letters.

At Bežigrad's Krater, at a creative laboratory in a construction pit (at the intersection of Peričeva ulica, Topniška ulica and Dunajska cesta). From October 2020 onwards, TRAJNA association will start implementing socially and environmentally responsive education at Krater, which will invite various artists and other curious citizens to design products from wood and paper made of IAPS. The workshop is suitable for designers, school groups, development of project or business ideas or tailored to the participants' wishes.

CONTACT

• Educational wood and paper workshops at Bežigrad's Krater: TRAJNA, association for the development of sustainable design, Dunajska cesta 56, 1000 Ljubljana

Gaja Mežnarić Osole, info@trajna.si Andrej Koruza, info@trajna.si

• Educational workshops with a tour of the pilot paper machine: Pulp and Paper Institute, Bogišićeva 8, 1000 Ljubljana

Tea Kapun, Ph.D., tea.kapun@icp-lj.si

• Educational workshops in hand-made paper artesian workshop: VOKA SNAGA, water and waste management public company, Vodovodna cesta 90, 1000 Ljubljana

Meta Vidovič, meta.vidovic@vokasnaga.si

• Workshops for making posters with wooden letters for letterpress printing: Institute and letterpress studio tipoRenesansa, Breg 22, 1000 Ljubljana

Marko Drpić, marko.drpic@tiporenesansa.com

HANDING OVER HARVESTED BIOMASS

After harvesting, the IAPS biomass must be appropriately sorted: parts that can be reused are processed into useful products, parts that cannot be reused and cannot re-grow can be composted, and the rest must be incinerated.

In Ljubljana, we started collecting IAPS biomass in 2014 as one of activities of the socially responsible campaign Gloves up! We have been upgrading our services over the past years, and our goal is to establish an IAPS collection point in every collection center in the City of Ljubljana and to process as much of the received material as possible.

So far, the received quantities of material are very small, and the material is usually not properly sorted. In the future, we will put more focus on the training of the staff of the collection center, as they can make a significant contribution to the increase in quantities by giving users as precise instructions as possible.

APPLAUSE PROJECT BENEFITS

Quantity of collected biomass at the Povšetova Collection Center: 400 kg of Japanese knotweed and 247 kg of Canadian and giant goldenrod

WHERE DO WE COLLECT THE IAPS BIOMASS IN LJUBLJANA?

Povšetova Collection Center

In 2018, we have set up a special collection point in the collection center on Povšetova ulica 2, where citizens were able to bring the harvested biomass of eleven IAPS. From 2021, we will continue to collect: Japanese and Bohemian knotweed, giant and Canadian goldenrod, and other species if needed. IAPS can also be submitted to the composting or incineration containers in accordance with the handover instructions. Instructions for handing over the IAPS biomass are available on the website of JP VOKA SNAGA and at the Povšetova Collection Center.

The Povšetova Collection Center is open from Tuesday to Saturday between 11am and 6pm. The collection center is closed on holidays and non-working days.



IAPS collection point at Povšetova collection center.

Barje Collection Center

The collection of IAPS for incineration in the Barje Collection Center has been taking place since 2014. In 2021, the Barje Collection Center will start to collect: Japanese and Bohemian knotweed, giant and Canadian goldenrod, and other species if needed. IAPS can also be submitted to the composting or incineration containers in accordance with the handover instructions. Instructions for handing over the IAPS biomass are available on the website of JP VOKA SNAGA and at the Barje Collection Center.

The Barje Collection Center is open from 1 April to 31 October: Monday to Saturday from 6am to 8pm and from 1 November to 31 March: Monday to Saturday from 6am to 8pm. The collection center is closed on holidays and non-working days.

CONTACT

 IAPS collection points: VOKA SNAGA, water and waste management public company, Vodovodna cesta 90, 1000 Ljubljana

Meta Vidovič, meta.vidovic@vokasnaga.si

NEW KNOWLEDGE AND OPPORTUNITIES

About 150 alien plant species can be found in nature, of which at least a third is invasive or potentially invasive.

The possibility of processing IAPS begins with the analysis of the material. Initially, as many different IAPS as possible should be tested to obtain as much information as possible about their potential applicability and availability. In the following steps, we reduce the selection of species and carry out a more targeted analysis.

We can make many useful things from leftover materials and cheap, easily accessible natural resources. The use of leftovers in biomass – lignin, dyes and polyhydroxyalkanoates – can be very diverse. Leftovers in biomass can be used to make hybrid colored coatings for glass and wood, natural dyes and as a source of various useful chemicals.

APPLAUSE PROJECT BENEFITS

Number of undergraduate and postgraduate students involved in the APPLAUSE project: 375

Number of patents: 1 and 1 in the process of obtaining

Number of published scientific articles: 25

Number of conference presentations: 70

Number of researchers involved: 92

Number of new materials: 8

Number of new recipes: 33

Number of new methods: 5

Number of new processes: 2

WHERE DO NEW OPPORTUNITIES ARISE?

We have developed a new, biotechnological way of solving the problem of IAPS, using bacteria that have naturally developed a trait for lignin degradation as a mechanism of plant cell invasion. We have used this trait to our advantage in the laboratory by adapting and optimizing it in our biotechnological process. To implement our approach, new isolates must first be successfully obtained from nature. Namely, the metabolism of lignin degradation was found in only a few out of 400 isolated bacteria obtained from Japanese knotweed, mainly from the root system and decomposing biomass. The selected isolates proved to be very successful degraders, as we degraded up to 80% of the lignin in the ground biomass of Japanese knotweed. The result of bacterial degradation can therefore be compared to the chemical approach currently used

in the paper industry. In addition, this process does not use toxic chemicals and surpasses many chemical processes in this respect. We have also shown that the method implementing bacteria at the industrial level of decomposition can be compared in price with chemical methods, despite the fact that the decomposition process using bacteria requires slightly more processing of the plant biomass.

The products of biotechnological delignification are (i) watersoluble derivatives of ferulic acid, which are an extremely good input material for various industrial processes, and (ii) a solid residue composed of cellulose. The latter contains short plant fibers, which cannot be used directly in the process of conventional papermaking. For this reason, we have developed a process that allows the production of an alternative form of paper, the so called »thin sheets«. This process combines the use of fine-grained biotechnologically delignified material using natural polymers that are either abundant (e.g. alginate) or represent waste material from another industry (e.g. chitosan). The material is a composite of flexible polymer molecules of chitosan, alginate, etc. and the less flexible material processed from plant biomass. The process of material preparation represents a new concept of fabrication of thin sheets based on the interaction of electrostatically differently charged polymers, shading of charges and the appropriate drying process. With different formulations of mixtures of salts and polymers and their processing, different strength, elasticity and brittleness of composites can be achieved. As a result, the production process itself and the produced material have a great variety of uses. If the material includes chitosan, it may also be suitable for food packaging or can serve as a binding material for different products, as the antimicrobial action of chitosan can promote faster wound healing and slow down food spoilage.

We also developed processes for the transformation of the obtained cellulose material into another form of polymer with higher added value. We developed a process for the transformation of cellulose using biocatalytic aggregates constructed from cellulolytic bacteria and bacteria capable of accumulating polyhydroxyalkanoates (PHA). The final PHA product can be used directly as a biodegradable plastic, as an additive for coating formulations to increase the hydrophobicity of surfaces or for the production of filaments in the manufacture of clothing. Novel uses could also be envisioned in the future.





(from top to bottom) Isolated bacterial strain of Japanese knotweed that effectively delignificates plant material. Thin layer made of delignified ground Japanese knotweed in combination with alginate. New opportunities are also emerging in the production of wood-plastic composites. We have prepared a working recipe that includes the choice of material, particle size, the best ratio of wood and plastic, the construction of the molds and the geometry of the finished products.

The wood residues obtained during primary processing of wood and the production of wood products are firstly grounded in a mill and secondly in a drum chipper to the desired particle size. In the next step, dried chips of invasive wood species are mixed with a polymer and a biodegradable compatibilizer in an optimal ratio. The mixture of wood chips and polymer is subsequently hot-pressed in a mold and cooled into a 3D product.

Nanofibrillated cellulose as a material has attracted significant interest over the past few years, especially in the biomedical field where it can be used for the manufacture of highly hydrophilic materials that can hold large amounts of water. These materials are also known as hydrogels. The potential of nanocellulose hydrogels or aerogels is great as they offer versatility and are, for the most part, benign in contact with human tissues.

Nanofibrillated cellulose was isolated from the cellulose of honey locust and staghorn sumac by a combination of chemical and mechanical processes. We developed a prototype of a nanocellulose composite based on a water-soluble polymer reinforced with nanocellulose fibrils and a prototype of a highly porous nanocellulose aerogel from a pre-prepared hydrogel that can be used in filtration systems.



(from left to right) Highly porous nanocellulose airgel. IAPS wood processing residues processed into a WPC (Wood Plastic Composite) container.

In cooperation with an external partner, we are developing new extraction processes with supercritical fluids (CO_2).

CONTACT

Coloid biology: Jožef Stefan Institute, Jamova 39, 1000 Ljubljana

Aleš Lapanje, Ph.D., ales.lapanje@ijs.si

• Dye extraction: National Institute of Chemistry, Department of Food Chemistry, Hajdrihova 19, 1000 Ljubljana

Irena Vovk, Ph.D., irena.vovk@ki.si Vesna Glavnik, Ph.D., vesna.glavnik@ki.si Jana Stanič, jana.stanic@ki.si

 Preparation of extracts for pest control: University of Ljubljana, Biotechnical Faculty, Department of Agronomy, Jamnikarjeva 101, 1000 Ljubljana

Tanja Bohinc, Ph.D., tanja.bohinc@bf.uni-lj.si Stanislav Trdan, Ph.D., stanislav.trdan@bf.uni-lj.si

 Preparation of 3D composites, nanocellulose: University of Ljubljana, Biotechnical Faculty, Department of Wood Science and Technology, Rožna Dolina, cesta VIII/34, 1000 Ljubljana

Maks Merela, Ph.D., maks.merela@bf.uni-lj.si

 Preparation of dyes and hybrid coatings: University of Ljubljana, Faculty of Chemistry and Chemical Technology, Department of Chemistry and Biochemistry, Večna pot 113, 1000 Ljubljana

Jernej Iskra, Ph.D., jernej.iskra@fkkt.uni-lj.si Monika Horvat, monika.horvat@fkkt.uni-lj.si

Preparation of dyes and recipes for dyeing textiles and printing textiles and paper: University
of Ljubljana, Faculty of Natural Sciences and Engineering, Department of Textiles, Graphic Arts
and Design,
Attractory active costs 12, 1000 Liubliana

Aškerčeva cesta 12, 1000 Ljubljana

Marija Gorjanc, Ph.D., marija.gorjanc@ntf.uni-lj.si



More about the APPLAUSE project www.ljubljana.si/en/applause/.



E-mail: applause@ljubljana.si

