Interreg

Aurora

Co-funded by the European Union

INSPIRE
INvasive SPecies Information Restoration & Engagement

Strategy Of Restoration

Restoring areas invaded by invasive alien species





Elinvoimakeskus

Länsstyrelsen Västerbotten

Interreg Aurora

Co-funded by the European Union

INSPIRE
INvasive SPecies Information Restoration & Engagement

Elinvoimakeskus

Länsstyrelsen Västerbotten

VAASA.VASA. VISIT VAASA FINLAND

UMEÅ KOMMUN

Title:	Strategy Of Restoration – Restoring areas invaded by invasive alien species
Author:	Linda Backlund, Markus Seppälä
Reference number:	Lst dnr 8535-2023
Year of publication:	2026
Cover image:	Top: Paula Hakala, Economic Development Centre of South Ostrobothnia Other images: County administrative board of Västerbotten
Address:	Länsstyrelsen Västerbotten, 901 86 Umeå
Telephone:	+46 10 225 40 00
Email:	vasterbotten@lansstyrelsen.se
Website:	www.lansstyrelsen.se/vasterbotten

Preface

Biodiversity is a prerequisite for life as we know it, and the basis for human existence and welfare. We can retrieve numerous services from our **ecosystem**s when they are healthy and the biodiversity is functional. Food, drinking water and fresh air, medicines, building material and fuel are just a few of the critical **ecosystem service**s. Healthy ecosystems are crucial for limiting the effects of global warming and they are more resilient to changes, including climate change-related events and catastrophes such as floods, drought and fires.

The quality of **habitat**s and ecosystems is however in alarming decline. Over 80 percent of the European habitats are in poor condition, and we are experiencing the greatest global loss of biodiversity in history. Many species have already gone extinct and a large number of species are endangered. Only in Sweden, more than 2000 species are endangered in some degree and many habitats have unfavourable conditions.

Ecosystem restoration usually concerns largescale activities like restoration of wetlands and meadows, forests burning, or watercourse restoration. Eradication of invasive **alien species** is however also an act of restoration, although passive restoration. By actively restoring habitats after invasive species invasion, the contribution to ecosystem restoration will increase.

INSPIRE is a cross-border Interreg Aurora project that has been working three years to test different restoration methods. Our test sites have been rather small, but we have gained a lot of knowledge about different methods. We have also found that it is beneficial to work with eradication and restoration simultaneously, regarding both time and costs.

This strategy was written primarily for municipalities and authorities and other actors that are planning habitat and ecosystem restoration activities. It also contains valuable information for anyone working with invasive species management in the field.

This strategy will be published before our countries have finished their national plans for nature restoration. We do not know how invasive alien species will be implemented in the national plans, but we sincerely hope that this strategy can be the start of a process where the management of invasive alien species are also focused on **habitat restoration**.

Thank you!
We would like to thank everyone who has, in one way or another, contributed to this strategy. We still have a lot to learn but this is a beginning. And as UN Decade on Ecosystem Restoration claims: Everyone can play a role in bringing back nature.

List of contents

1. INTRODUCTION AND BACKGROUND 5
1.2 Why do we need to restore habitats? 10
1.3 What is habitat restoration in practice 12
1.4 When do we need active restoration 15

2. ACTIVE RESTORATION 19
2.1 How to plan a restoration project 19
2.2 Methods for eradication 24
2.3 Methods for active restoration 25
2.3.1 Method: Jute hessian-cover combined with a layer of soil, and sowing seeds 26
2.3.2 Method: Jute/hessian-cover combined with replanting 27
2.3.3 Method: Seed and plugplants after eradication with cover 29
2.3.4 Method: Digging combined with sowing seeds 30
2.3.5 Method: Digging combined with sowing seeds sourced from the site 31
2.3.6 Method: Digging combined with replanting 32
2.3.7 Method: Root pulling combined with sowing seeds the second year 33
2.3.8 Method: Mowing combined with sowing seeds the second year 34
2.3.9 Interesting methods that has not been used by the project 35

3. SUMMARY OF RESTORATION TESTING RESULTS FROM INSPIRE PROJECT ... 37

4. EXAMPLES OF RESTORATION PROJECTS 42
Examples of (successful) restoration projects/methods 42

ATTATCHMENT 1. Plug plants and seed mix used in Västerbotten, Sweden 52

ATTATCHMENT 2. The INSPIRE project 53

ATTATCHMENT 3. Glossary 54

The INSPIRE project contributes to the following UN Sustainable Development Goals (SDG)



1. Introduction and background

One of the main driving forces behind the ongoing worldwide decline in biodiversity is the degradation of habitats and ecosystems. More than 80 percent of the habitats are in poor condition only in Europe[1], and from a global perspective we are in the middle of the sixth mass extinction of species. Alongside habitat and ecosystem degradation, invasive alien species, exploitation of species, climate change and pollution are also causing significant negative impacts on biodiversity.

The UN has declared the 2020's as the ***Decade on Ecosystem Restoration***. Working towards a more sustainable environment includes assisting degraded or destroyed ecosystems to better or even their original state. The EU Nature Restoration Regulation is the first continent-wide, comprehensive law of its kind and a key element of the EU Biodiversity Strategy. Working together to improve the conditions of degraded or destroyed ecosystems will not only result in increased biodiversity on a geographically large scale, but it will also lead to healthier and more resilient environments for humans, more fertile soils and larger stores for climate carbon.

In their 2023 report[2], the UN Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, IPBES, showed that more than 60 percent of the known species extinctions have been caused solely or partially by invasive alien species. 16 % of the extinctions were solely caused by invasive alien species. Invasive species can be found all around the world and in all types of habitats and ecosystems. They are known to have caused dramatic, and sometimes irreversible, changes to ecosystems and therefore invasive alien species management inevitably need to be a part of the ecosystem restoration work. Moreover, invasive species are more likely to invade and negatively impact ecosystems that are already degraded. Removal and actively restoring habitats that they have damaged are therefore also contributing to the goal of the ecosystem restoration.

The cost of inaction grows larger

The financial cost of not acting on the spread of invasive species has been evaluated to be over 400 billion euros per annum globally, with costs quadrupling (4X) every decade since the 1970's (IPBES 2023). The financial impact has already been significant to agriculture and forestry. IPBES

[1] Conservation status of habitats under the EU Habitats Directive | Indicators | European Environment Agency (EEA) https://www.eea.europa.eu/en/analysis/indicators/conservation-status-of-habitats-under

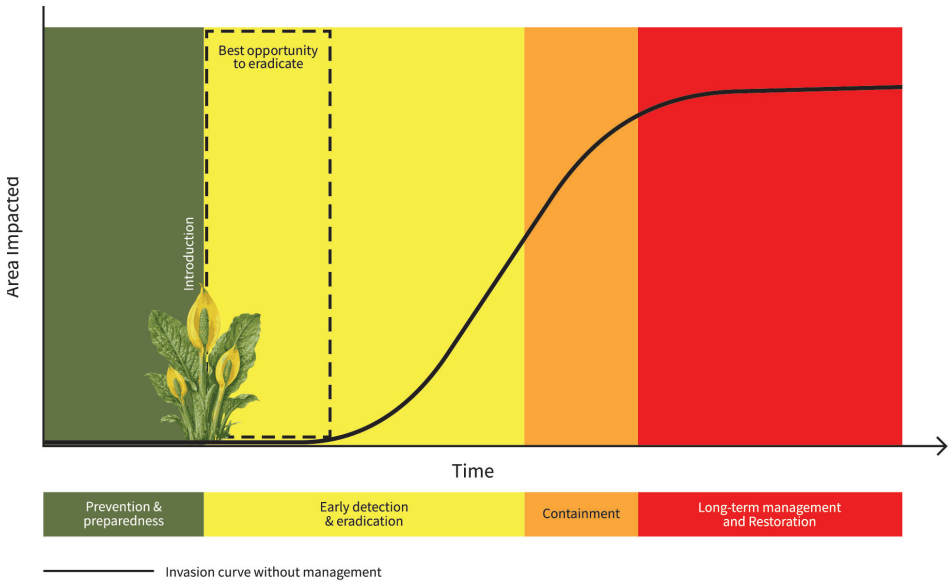
[2] Thematic Assessment Report on Invasive Alien Species and their Control | IPBES secretariat https://www.ipbes.net/ias

evaluated that in 2019 the global cost of invasive species was 423 billion USD, where 92 % of costs attributed to loss of agricultural yields, problems caused to clean water management and diseases caused by invasive alien species. Only 8 % of costs were used in invasive alien species eradication and management.

We also see the cost of inaction in Sweden and Finland. Many habitats are heavily affected by invasive alien species, and the management already requires more resources than are available.

Early detection and rapid response

The only way to stop the negative impacts on the ecosystems is to prevent spread of the invasive alien species, detect newly established invasive alien species early followed by rapid eradication. Ecosystems will be more damaged, and the costs of eradication will increase if nothing is done, see picture 1. Eventually restoration will be necessary as the damage on the ecosystem is too extensive.



Picture 1. Levels of invasiveness: Early prevention of establishment of invasive alien species results in lesser negative impact on the ecosystem.

The ecological benefits that are gained from restoration activities are expected to be far greater than the actual economic cost. These benefits are estimated to come from for example enhanced food production, carbon sequestration, mitigation of climate change eg. carbon storage and improved water quality.

1.1 Legislation concerning restoration work

Global perspective, goals and strategies

The international work for ecosystem and biodiversity restoration began over 20 years ago with Forest and Landscape Restoration partnerships. It was continued by UN conventions on biodiversity (CBD) and combatting against desertification (UNCCD), setting global milestones such as the Aichi Targets for 2011-2020 for halting biodiversity loss and promoting sustainable development. Although the Aichi Targets were not met by many of the participating countries, the framework was crucial as a blueprint for present objectives set by the 2022 Kunming-Montreal Global Biodiversity Framework goals.

EU Biodiversity Strategy for 2030

The goal of the EU biodiversity strategy is to establish an EU-wide network of protected areas on land and sea, launch a legally binding nature restoration legislation and ensure better implementation by improved knowledge, investment and financial offers and financial offers.

EU Restoration Law

Restoration of degraded or destroyed habitats and ecosystems became mandatory in the EU area after the ***EU Nature Restoration Regulation*** (2024/1991) entered into force in August 2024. This regulation aims to restore a broad range of ecosystems, habitats and species in EU's land and sea area, and to harmonize nature conservation across all members states. The efforts put into restoration will improve food security, promote ecosystems and help EU meet its international commitments under the Kunming-Montreal Global Biodiversity Framework.

EU member states are to develop National Restoration Plans, with milestones for 2030, 2040 and 2050, by September 2026. The legally binding target is thereafter to start applying restoration measures on at least 20 percent of land and 20 percent of sea areas by 2030, and in all ecosystems in need of restoration measures by 2050.

The overarching goals of the Nature restoration regulation is:

1	Stop the decrease of biodiversity. Sustain a long-term recovery of biodiversity and resilient ecosystems
2	Contribute to EU-s objectives concerning climate change mitigation and adaptation and land degradation neutrality (limit global warming to 1.5°C)
3	Secure the services nature does for free, like cleaning our water and air, pollinating crops, and protecting us from floods
4	Build up Europe's resilience and strategic autonomy, preventing natural disasters and reducing risks to food security

Legislation for invasive species

EU's Invasive Alien Species Regulation (1143/2014) consists of a set of measures to combat and prevent the spread of invasive alien species. The EU regulation is also implemented nationally in both Finnish (1709/2015) and Swedish legislature.

The EU regulation allows member states to have national lists of invasive alien species of national concern. Finland established a national list in 2016 and Sweden in 2026. More information about the lists can be found on the national IAS portal[3] in Finland and Naturvårdsverket[4] and Havs- och vattenmyndigheten[5] in Sweden.

INVASIVE ALIEN SPECIES OF EU OR NATIONAL CONCERN SHALL NOT BE INTENTIONALLY:

- brought into the terrotory of the Union
- kept or bred
- transported to, from or within the Union, except for transportation in the context of eradication
- placed on the market, used or exchanged permitted to reproduce, grown or cultivated
- released into the invironment

Exceptions for certain nationally listed species can occur.

[3]Invasive Alien Species Portal https://vieraslajit.fi/
[4]Invasiva främmande arter – djur och växter https://www.naturvardsverket.se/amnesomraden/invasiva-frammande-arter/nationell-forteckning-over-invasiva-frammande-arter/
[5]Invasiva främmande arter - Arter och livsmiljöer - Havs- och vattenmyndigheten https://www.havochvatten.se/arter-och-livsmiljoer/invasiva-frammande-arter.html

The EU invasive alien species regulation also includes restoration objectives. Article 20 declares that member states shall carry out appropriate restoration measures to assist recovery of an ecosystem that has been degraded, damaged or destroyed by invasive alien species unless cost-benefit analysis shows that the benefits of the restoration measures are too small.

National restoration plans

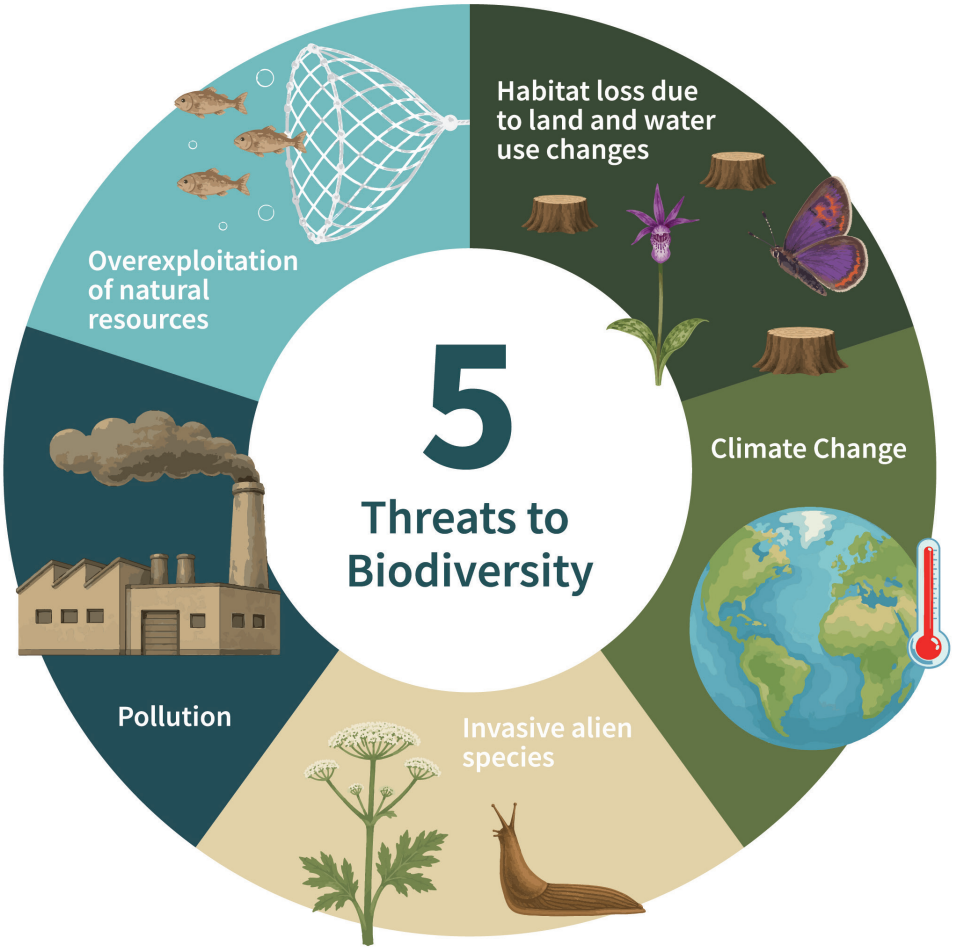
The national plans for restoration have not yet been approved as this strategy is written. The plans for both countries are however extensive, and they include for example restoration measures for forest-, agricultural- and mountain ecosystems, urban ecosystems and freshwater- wetland- and marine ecosystems. There are also measures connected to pollinators and species habitats amongst others.

In Finland, nature restoration work has been undertaken by government officials and municipalities with funding from different programmes such Helmi, METSO, Ahti, SOTKA and NOUSU, under EU-s agricultural CAP-funding.

Responsible central authorities in Sweden are Naturvårdsverket (Swedish Environmental Protection Agency), Havs- och vattenmyndigheten (Swedish Agency for Marine and Water Management), Skogsstyrelsen (the Swedish Forest Agency), Jordbruksverket (the Swedish Board of Agriculture) and Boverket (the Swedish National Board of Housing, Building and Planning).

1.2 Why do we need to restore habitats?

Habitat loss is one of the major driving forces behind the dramatic decrease in biodiversity. During the last century, many ecosystems have gone through major changes; farmland is used more extensively than ever, wetlands disappear and water courses are altered for hydroelectricity. Forests are often grown as monocultures and the number of meadows is steadily decreasing. In addition to habitat loss, the impact of climate change, natural resources overexploitation, invasive alien species and pollution are also driving forces resulting in the loss of biodiversity, picture 2.



Picture 2. Illustration that shows the five major forces that impact biodiversity.

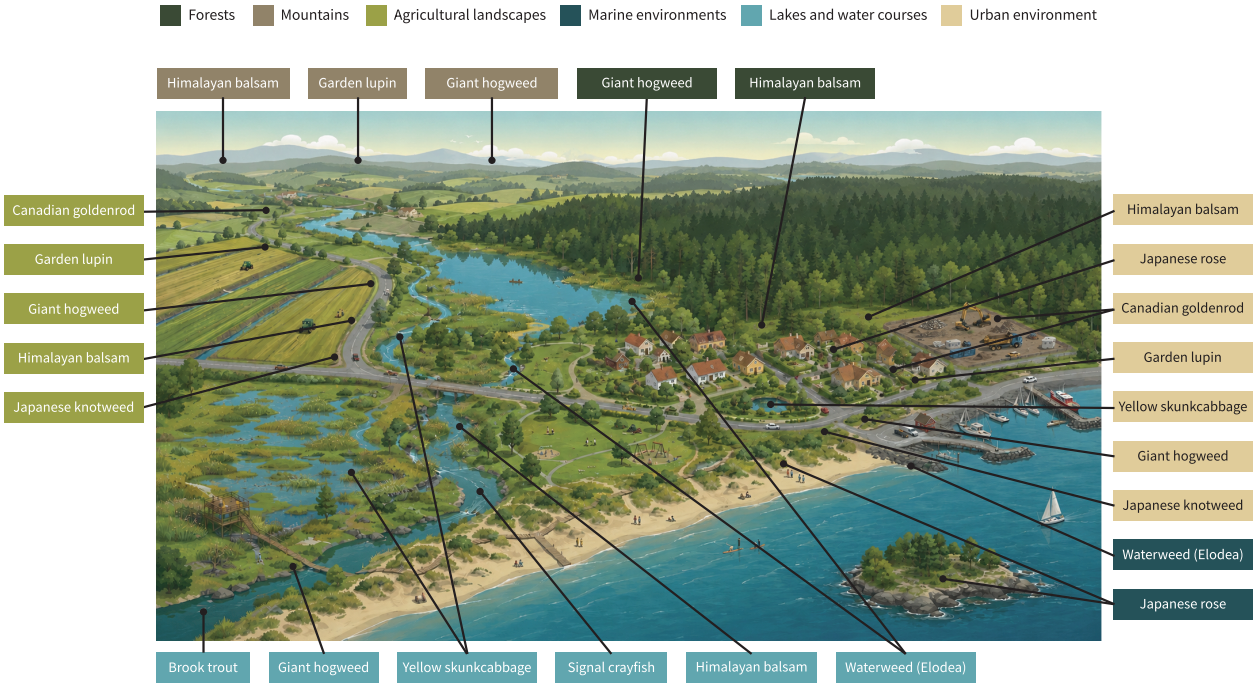
Invasive alien species can have profound impacts on ecosystems and habitats they invade, and ultimately decrease habitat quality for native species. Increased competition for space, predation and herbivory are direct negative effects, but invasive alien species can also alter nutrient conditions in the soil, carry diseases or parasites, decrease germination and alter fire regimes and hydrology. Ultimately invasive species risk affecting ecosystem function and ecological relationships between native species.

Cascading effects of invasive species to the complicated nutrient webs of native species can be difficult to identify and predict. Furthermore, aggregated effects of multiple invasive alien species can have large and complex impacts in an ecosystem. Restoring habitats from invasive alien species will inevitably result in positive effects for the native species, in one way or another.



1.3 What is habitat restoration in practice

Long-term recovery of damaged ecosystems usually require many different restoration measures depending on the habitat. Building wildlife crossings, rescuing and large trees, or removing fish barriers are some examples. What differs removal of invasive alien species from other restoration measures is that these species can be found in many habitats and ecosystems and consists of different species, see picture 3. Each invasive species require specific eradication methods and many years of labour and surveillance before the eradication result can be considered successful.



Picture 3. Invasive alien species can be found in many habitats and ecosystems. Eradication and restoration of IAS-effected areas can therefore contribute to increasing biodiversity at a larger scale.

Restoration measures can be either passive or active. ***Passive restoration*** means that the damaged area is allowed to recover by itself as the threat is removed. ***Active restoration*** is often needed when ecosystems have been heavily damaged. Not only the source of degradation needs to be removed, but the system also needs help to get “back on track”. Some restoration methods can be considered both passive or active, depending on the specific goals and type of habitat that is being restored. Grazing animals can for example be used to remove invasive plant species but can also restore a former pasture or meadow closer to its previous state.

Passive restoration measures against invasive alien species

Removal, or eradication, of invasive alien species is similar to passive restoration measures. The habitat restores itself as the number and cover of invasive plants, or the number of invasive animals, decreases throughout the eradication process. The restoration process starts as soon as the invasive species removal begins, as the available light and space can be taken back by native species. Eradication measures in an early phase of establishment rarely requires any active restoration efforts.

The ***key for success*** when it comes to passive restoration measures is preventing reestablishment by the same or other invasive species.

BY PERFORMING LONGTERM SURVEY OF THE AREAS YOU WILL:

- Prevent the seedbank and/or propagules to grow
- Prevent seed arrival and novel invaders from nearby areas to establish
- Have the option to monitor the increase in number and cover percentage of native species and learn more about the restoration process

Active restoration measures against invasive alien species

Once invasive alien species have been allowed to spread, the negative effect of the ecosystem can be severe, both in structure and species composition. When invasive alien species are firmly established in a habitat, only few plant communities return to its original species composition when only management (eradication) measures have been performed (Singh and Byun 2023)[6]. The conditions that were in the past will not be there in the future. For example, Garden lupin is a nitrogen fixing species, which makes the soil more fertilized. Also, some species such as Himalayan balsam, Canadian rod and *Elodea*-species, are using **allelopathy** as an invasion mechanism, which means that they produce biochemicals that influence germination, reproduction and survival of other species.

[6] Singh and Byun 2023. Ecological restoration after management of invasive alien species. Ecological engineering, volume 197, 2023.

The eradication method itself can also be the reason why active restoration measures are needed. Digging and covering are very efficient eradication methods for japanese rose, *Rosa rugosa*, but it can leave the habitat heavily changed. The natural restoration will often take a long time. For example, when Japanese rose was covered for three years in the archipelago in Västerbotten, only 40 % of the area was regrown two years after removing the cover, see picture 4. The positive effect is however that only native species have been reestablishing.



Picture 4. Japanese rose that was covered for three years (2020 – 2022). In 2023 the cover was removed, and the area was let to restore itself. The picture in the bottom shows the state of the area after two growing seasons (Holmön, 26th of August 2025). Vegetation is now covering approximately 40 % of the area and only native species from the area have reestablished.

1.4 When do we need active restoration

We can work with nature restoration in a numerous ways but the time and economic resources are often limited. We will need to prioritize when and where measures must be taken, and how they can be done as efficiently as possible. Furthermore, all EU member states will have their own national restoration plans (See page 9). It is therefore recommended that the restoration actions concerning invasive alien species align with the national restoration plan.



Habitats that are prioritized in the national restoration plan are probably more important to restore also considering invasive alien species

There are several aspects that need to be considered when deciding whether active restoration measures are necessary. Priorities should be based on both ecological effects and financial resources.

Here you find several statements; the more boxes you can check, the more likely it is that active restoration is needed.

A	☐	The habitat cannot restore itself to its natural state and in a reasonable amount of time if only invasive alien species eradication takes place.
B	☐	The habitat invaded by invasive species belong to threatened or endangered habitat types, ie. Red List
C	☐	The invasive alien species threaten endangered or Red Listed native species
D	☐	The location is within a protected area with important landscape and nature. Features. Areas can be protected not only because of specific species but also for the specific nature type. For example, Japanese rose is a threat to sandy areas along the coast. This ecosystem is important to many sandfavoured species.
E	☐	The habitat is severely damaged. For example, the invasive species is allelopathic and alters the soil by releasing biochemicals, or the invasive plan fix nitrogen and fertilizes the soil. It can also be damaged due to eradication methods such as covering or digging.
F	☐	Ecosystem services are threatened
G	☐	The species richness has dropped significantly due to the invasive species (plants or insects).
H	☐	The invasive alien species changes the prerequisites for endangered species to exist och establish. Remember to take into consideration all life cycle stages for the endangered species.
I	☐	The green infrastructure is negatively affected.
J	☐	There are economic benefits of active restoration. Restoration can decrease the need and cost for future eradication as eradication measures can be expensive and time-consuming. Restoring an area in tandem with eradication measures can reduce the cost for future eradication and restoration measures. Read more in page 25.

In the northern parts of Sweden and Finland we have been able to identify following invasive species areas that often need active restoration measures, see table 1.

Table 1. High-priority invasive alien species affected areas that often need active restoration, and identified problems and threats within the areas.

Situation that can require restoration	Overlaying problems	Identified major threats
Himalayan balsam in steep slopes	A, E, F, G Potentially: B, C, D, I, J	Erosion, allelopathic, pollinators preference
Japanese rose in sandy coastal areas	A, B, C, D, E, F, G Potentially: I, J	Dense, impervious vegetation, pollinators preference, changes coastal dune habitats and threatens endangered flora and insects.
Flower lupin in meadows	A, E, F, G, H Potentially: B, C, D, I	Dense vegetation, increase nitrogen, harmful to bumblebee reproduction success
Flower lupin on roadsides with endagered native flora	A, B, C, E, F, G, H, I Potentially: J	Dense vegetation, increase in nitrogen unsuitable for native species
Canadian golden rod in meadows	A, E, F, G, I, H Potentially: B, C, D	Dense vegetation, allelopathic, pollinators preference
Elodea in shallow ocean bays or lakes	A, E, G, H Potentially: B, C, D	Dense vegetation, allelopathic effects on cyanobacteria and aquatic plants
Invasive alien species in flood plains for smaller water coarses	A, E, G, Potentially: B, C, D, E, H,	Prevents water flow, decreases quality of fry areas
Areas eradicated with covering	A, E, G, Potentially: B, C, D, F, I,	No species left where the cover was. The bigger the cover, the greater the damage
Himalayan balsam in coastal meadows	A, E, F, G, H, I, J Potentially: B, C, D,	Allelopathic, loss of invertebrate diversity, pollinators preference
Yellow skunk cabbage in wetlands	A, B, C, E, G, H, Potentially: D, F, I, J	Dense vegetation, high risk of spread to natural environments

Once we have identified an area that requires active restoration, we can start thinking about how we will go through with it. What kind of restoration measures needed can and will vary from one place to another. Its current state of degradation, species composition and sensitivity to change are all factors that affects the options for methods of restoration.



Garden lupines have established in a meadow and are now spreading towards the road area. 200 m from the meadow, the highly endangered butterfly Violet copper, *Lycaena helle*, has its´s egg nesting site. The butterfly is dependent on the flower Common bistort, *Bistorta vivipara*. If the Garden lupin is allowed to spread the bistort will be outcompeted and the Violet copper-butterfly will go extinct in this habitat. Instead of only eradicating the lupine, the area is restored by translocation of native plants combined with undersowing of meadow species. In that way the area will reach a more native state faster than if only lupines were removed.

2. Active restoration

2.1 How to plan a restoration project

Once you have decided that active restoration is needed, the planning phase begins. A project that is carefully planned will most likely give better long-term results. Use the following checklist, table 2, to make sure nothing is forgotten or missed:

Table 2. Checklist for planning a restoration project.

	Activity	Comments
☐	Survey	Detailed surveys of species and habitat types in the restoration area. Have both invasive alien species and pristine areas in mind and look for invasive species outside the project area. Make a detailed plan for monitoring and surveillance to prevent invasive species reestablishment
☐	Define goals	What is the best result that can be achieved with the budget and methods available. Make your goals clear and achievable
☐	Office work	Investigate relevant regulations, necessary permits, contacts with concerned landowners, financial funding etc. Plan well in advance, permits can take time to be processed!
☐	Choose methods	Read more about restoration methods in chapter 2.3. Don't forget to plan for eradication methods if that will to be done simultaneously. Eradication methods are described in www.metodkatalogen.se
☐	Fieldwork preparations	Make sure that you have the necessary labor, equipment, vehicles and logistics well before starting work. Make sure to add time for documentation as well as work itself.
☐	Fieldwork	Have a nice day making a difference!
☐	Evaluation	Document and communicate lessons learned for future restoration activities. Also document progress of restoration if budget and time allows

Survey

When an area in need of restoration has been identified, a detailed survey should be conducted. Identify and quantify invasive alien species in the area. Also investigate nearby areas, which can be of importance when choosing restoration methods. Aim to answer following questions:

- How do the invasive alien species spread to the area, and is the pathway still “active”?
- Is there any risk of soil erosion (riverbanks) due to annual invasive species?
- Are there any nearby populations of invasive alien species that might spread to the restored area? Should they be eradicated simultaneously with the restoration work? If so, monitor and include also these areas in your reporting.
- Are there nearby areas that can work as model or donor areas - can seeds or plants be harvested from there?
- Which landowners (stakeholders) are concerned and maybe must be negotiated with?
- Does the location or topography limit the possible restoration methods? Slopes, island or other remote areas with decreased accessibility?
- Are there any work safety issues to consider? Steep slopes, difficult terrain to move, harmful invasive alien species? Do you need to remove obstacles, like bushes or trees to be able to work in the area?
- Document the baseline data from the site and then define your success metrics, e.g. indicators you monitor during the project (invasive and native species cover percentage, overall species richness, changes in soil characteristics.

Sometimes a restoration project needs to be carefully documented, with extensive data collection. Table 3 shows measures that might be of importance for such projects. A carefully planned project should include how the process is documented and key monitoring data managed and analyzed. Results can be visualized by following the change in plant and pollinator species numbers and cover. Define therefore what variables (examples in table below) are relevant for you to monitor to achieve your goal.

Table 3. List of baseline data that can be of importance for future analyses.

Monitoring, Photography & Documentation — A Checklist		
What to measure – what to consider?	**Key Actions**	**Why It Matters**
Baseline Data – Pre-restoration conditions	Conduct vegetation surveys, soil tests, wildlife observations, take initial photos	Provides a reference for measuring change
Monitoring Frequency – Timing and repetition	Set schedule (baseline, seasonal, annual)	Captures trends and seasonal variation
Photo Monitoring – Quality and repeatability of images	Establish fixed photo points or transects with markers at the site	Enables accurate before–after comparisons
Vegetation Monitoring – Plant community recovery	Use quadrats, transects, percentage cover estimates, survival counts. Check also for changes in IAS outside the project area.	Tracks restoration progress and success directly
Fauna Monitoring – Wildlife return rate	Conduct bird counts, pollinator surveys, camera trapping if needed	Indicates ecosystem recovery and function
Soil Monitoring – Soil health changes	Measure organic matter, infiltration, pH, nutrient elementals (N, P, K, Mg, K, Na, Zn, Mn…)	Soil condition underpins long-term success for example in meadow restoration
Adaptive Management – Use results to adjust plans	Set thresholds and modify management based on findings	Improves outcomes over time
Data Management – Storage and organization	Use standardized methods and frameworks, back up data	Prevents data loss and supports analysis
Photo/File Organization – Image management	Use clear naming conventions and folder structures	Makes photo retrieval and comparison easy
Mapping & Spatial Data – Site tracking	Map plots, photo points, invasive areas (GIS if possible)	Helps visualize patterns and changes
Reporting – Communicating results	Prepare periodic reports with photos, monitoring results with metrics, and summaries	Supports transparency and funding justification

Define goals

What is the goal of the restoration? The previous natural state is seldom reachable, but it is still necessary to visualize the possible outcome. Be sure the goal is achievable within the budget and timeframe. If you don't have the resources to do all the measures you have determined a successful restoration project need, prioritize the parts that you estimate to give the best results. Also define risks with the work. By doing so, the goals will be more realistic.

Office work

Depending on where the restoration is taking place, there are several assignments to go through before the work can begin:

- Protected area? Some methods might not be allowed to use without permission, such as digging with large machines.
- Bird nesting season? During this season (roughly from beginning of April to the middle of August), it might not be suitable to do the field work as the birds will be disturbed and nesting risks being disrupted. Special permits can be applied from Lupa ja Valvontavirasto/Länsstyrelsen.
- Are other landowners affected by the restoration and do they need to be included in the process? Be sure to contact them well ahead before starting, for permission to work on their land or the choice of methods. Discuss the restoration area, what will happen, who will do it and who are economically responsible.
- Apply for project financing if the restoration demands long-term financing. This overrides the problems with annual budgets, as in municipal and governmental authorities. The benefit of projects is that they have a clear timeframe and available economic resources. Identify the different procedures of the restoration work and don´t undercalculate.
- When calculating the costs, remember to include monitoring work several years after restoration has been finished.
- Plan for safety issues if any were identified during the survey. Calculate for the need of special skills or tools if needed.

Choose methods

All methods, whether for eradication or restoration, should always be suited for the specific site conditions and the species in question. Read more about different restoration methods in chapter 2.3 Active Restoration methods. Restoration activities can be performed after eradication measures, but it can also be done simultaneously. The latter can be more cost-efficient as the goal for the restoration is reached faster.

TAKE FOLLOWING FACTORS INTO CONSIDERATION WHEN CHOOSING METHODS:

- How has the area been degraded? In what way has the invasive species effected the site? If the soil for example has been degraded, seed germination ability from native plants can be lower.
- Does the location of the site limit the possible methods? For example, access for heavy machines, protected area that restrains the allowed methods?
- If the restoration area is a steep slope, consider the safety during the actual field work (risk of falling). Also consider the risk of erosion during the time of restoration. The goal would probably be to use a method stops or minimises the risk of erosion as soon as possible.

Fieldwork preparations

Make sure that you have the necessary labor, equipment, vehicles and logistics well before starting work. Also plan for waste management if needed. Make sure to add time for documentation as well as work itself.

Fieldwork

Make sure that you don't inadvertently spread invasive species because of your work. You can review another publication from the INSPIRE-project: The IAS guide for municipalities. Here you can read about suitable biosecurity measures when removing invasive species.

Enjoy your day outdoors!

Evaluation

The time for follow-up surveys need to be adjusted to the invasive alien species that has been removed. Seed bank, the time for a plant to flower and produce seeds, vegetative dispersal or only by seeds. If the seed bank is eight years long, then you should plan for yearly visits for preferably eight years. If the time is limited, plan for yearly visits during the first years, then plan visits to the area at least every second year.



Without follow-up surveys, reinvasion by invasive alien species can go unnoticed and leave the restoration process with no results. That would be a waste of time and resources

2.2 Methods for eradication

METHODS FOR ERADICATION SHOULD ALWAYS BE CHOSEN BASED ON SEVERAL FACTORS:

- Site-specific conditions
- Economic resources
- Available labor
- Available time
- Waste management

Accessibility, distance to water or other pathways of dispersal, size of the population, topography and type of ground are all important site-specific conditions. Accessibility is particularly important as many methods need repeated eradication actions. The accessibility also determines the waste management practices.

Pay attention to correct timing of removal. Each invasive species has its optimal time for cost-effective removal treatments. Find out about the target species ecology and biology for optimal timing. An example could be when meadows are cut in late summer; make sure you have done all invasive species removal work before that as it will minimizes the risk of the invasive alien species dispersal due to cutting.

Naturvårdsverket in Sweden has gathered knowledge about eradication methods for several invasive alien species in Metodkatalogen. Here you can find for example descriptions of the methods, necessary tools, cost estimates, advantages and disadvantages.

Chemical methods, such as herbicides are sometimes used in controlling invasive plant species, but they are not discussed in this publication because the use of herbicides would probably be counterproductive in restoration projects.

2.3 Methods for active restoration

Habitat and ecosystem restoration can include many measures and methods that aim to improve the ecological status. Usually, a single method or measure with highest foreseen benefits is used to steer the habitat towards its natural state. Think of it this way: how much help do you think the habitat or ecosystem needs to recover to a better state? For instance, the singular method for restoring earlier hydrological status through raising the water level in swamp or wetland ecosystems is by blocking man-made ditches.

When restoring an area by adding seeds or plants, always choose native species. A good option would be to use “pioneer” species that are usually the first plant species to appear after bare soil appears due to land use change or other disturbance.

It is possible to do both restoration work and invasive species removal at the same time. This can be both cost- and time-efficient as invasive alien species are very good at re-establishing. It also results in making it more difficult for the invasive plant to regrow or for its seeds to germinate as “the spot is already taken”.



Always use native species when adding seeds or young plants

2.3.1 Method: Jute hessian-cover combined with a layer of soil, and sowing seeds



Eradication and restoration simultaneously
Suitable for species that can be eradicated by covering, for example Himalayan balsam, Canadian goldenrod and lupines. Possibly also suitable for Japanese rose and Giant hogweed.

Description:

Cut down the invasive plants close to the ground, remove the plant waste and cover the area with double folded, dense jute/hessian (preferably around 450 g/m2). Directly after, put 10 cm of soil on top of the jute/hessian and sow seeds. Trample the seeds into the ground or use purpose-built equipment.

Can be combined with planting plugplants or replanting with native plants from nearby.

Benefits:

The restoration process starts immediately. If performed in spring/early summer, the vegetation cover is dense before the summer has ended.

Jute/hessian is degradable, no need to be removed.

For restoration after removal allelopathic species the success rate for seed germination can increase when new soil is added.

Disadvantage:

Can need watering if the summer is dry.

Economics:

Material needed: jute, soil, seeds and maybe plugplants

2.3.2 Method: Jute/hessian-cover combined with replanting



Eradication and restoration partly simultaneously

Suitable for species that can be eradicated by covering, for example Himalayan balsam, Japanese rose and lupines. Possibly also suitable for Giant hogweed and Canadian goldenrod.

Description:

Cut down the invasive plants close to the ground, remove the plant waste and cover the area with doublefolded, dense jute/hessian (preferably around 450 g/m2). Leave the cover for one year.

After one year of cover, cut small holes in the jute/hessian and plant a native plant within the hole. Seal the hole around the new plant as much as possible with soil and rocks to prevent sunlight to reach under the jute/hessian. This is especially important when eradicating Japanese rose as they will keep growing if the light reaches the plant and can then grow through the jute/hessian.

Can be combined with commercial plugplants if native plants from nearby are not available.

Transplanting requires knowledge of species previously present on the site, or suitable to the restoration site. The donor site should be selected from nearby, ensuring the material is adapted to local environment conditions. Donor site should have the focus species in abundance, that even after moving 25 % of the population there shouldn't be long-term harmful effects. Transplanting can be done by transferring one or more single species, or moving a portion of topsoil with seed bank included. Make sure you have permission to remove plants from the donor site.

Replanting should be carried out when the risk of dehydration is low. If you cannot water continuously, replant during spring or autumn.

Benefits:

Jute/hessian is degradable, no need to be removed.

Restoration is done in an early stage of eradication.

Disadvantage:

Can need watering if the summer is dry.

Economics:

Material needed: jute/hessian

2.3.3 Method: Seed and plugplants after eradication with cover



Eradication and restoration separately

Suitable when quick restoration is needed as the ground lacks vegetation cover, for example slopes that has been covered with Himalayan balsam.

Description:

Remember to order the seeds and plug plants one year before the restoration will take place! Unless the area is planned to be managed as a meadow, you don´t need specific meadow species but could rather plant first-succession species.

Remove the cover and plant plugplants and sow seeds. See examples of suitable species for the whole of Västerbotten county in Appendix 1.

Benefits:

Restoration is done immediately. If performed in spring/early summer, the vegetation cover is dense before the summer has ended.

Disadvantage:

Can need watering if the summer is dry.

Economics:

Material needed: plug plants, seeds.

2.3.4 Method: Digging combined with sowing seeds



Eradication and restoration simultaneously

Suitable for species that can be eradicated by digging and preferably that also flowers after a few years, for example lupines and Giant hogweed.

Description:

Dig up the invasive plants with as much root as possible, fill the hole with soil and sow seeds. Trample the seeds into the ground or use purpose-built equipment.

Benefits:

Restoration process starts immediately. If performed in spring/early summer, the vegetation cover is dense before the summer has ended.

Disadvantage:

Can need watering if the summer is dry. Digging is time-consuming and physically demanding if the restoration area is large.

Economics:

Material needed: Seeds

Always aim for the outcome of the restoration to be as close to its original natural state as possible

2.3.5 Method: Digging combined with sowing seeds sourced from the site



Eradication and restoration overlapping.

Suitable for species that can be eradicated by digging, for example lupines and Giant hogweed.

Description:

Dig up the invasive plants with as much root as possible. Gather seeds from the native plant species at the site and sow them on the area the invasive species was removed. You can wait for end of summer to have more options with seed carrying native species. Trample the seeds into the ground or use purpose-built equipment. You can repeat the process next or each year for better results.

Benefits:

By sowing seeds from the site yourself, you help the native species to reinvade their space more quickly and add more competition to invasive species.

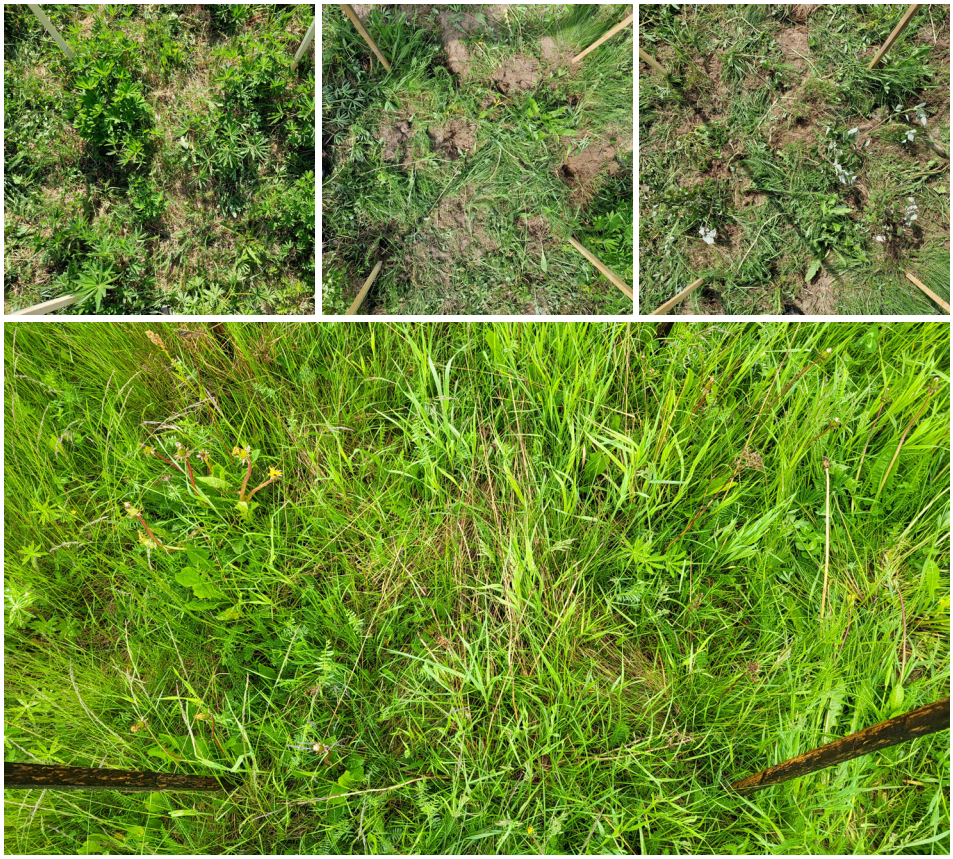
Disadvantage:

You may need to consider watering the area for better results if the summer is dry. Digging is time-consuming and physically demanding if the restoration area is large.

Economics:

Material needed: Seeds

2.3.6 Method: Digging combined with replanting



Eradication and restoration simultaneously

Suitable for species that can be eradicated by digging and preferably that also flowers after a few years, for example lupins, giant hogweeds

Description:

Dig up the invasive plants with as much root as possible and then replant a native species directly in the hole. Can be combined with sowing seeds or plug plants if native plants from nearby are limited.

Transplanting requires knowledge of species previously present on the site, or suitable to the restoration site. The donor site should be selected from nearby, ensuring the material is adapted to local environment conditions. Donor site should have the focus species in abundance, that even after moving 25 % of the population there shouldn't be long-term harmful effects. Transplanting can be done by transferring one or more single species, or moving a portion of topsoil with seed bank included. Make sure you have permission to remove plants from the donor site.

Replanting should be carried out when the risk of dehydration is low. If you cannot water continuously, replant during spring or autumn

Benefits:

Restoration is done immediately, especially if the replanted plant is from the same location.

Disadvantage:

Can need watering if the summer is dry. Digging is time-consuming and physically demanding if the restoration area is large.

Economics:

No material needed (unless plug plants are necessary)

2.3.7 Method: Root pulling combined with sowing seeds the second year



Eradication and restoration simultaneously
Suitable for Himalayan balsam.

Description:

Pull up the plants with their roots and sow seeds in the open spaces. Add seeds after the first eradication event in the second year of eradication.

Benefits:

Restoration is done at the same time as eradication is ongoing. The natural species will help decrease the spreading of the invasive alien species.

Disadvantage:

Can need watering if the summer is dry. Root pulling is time-consuming and is not suitable for large stands.

Himalayan balsam is allelopathic and can reduce the germination of seeds of native species.

Economics:

Material needed: Seeds

2.3.8 Method: Mowing combined with sowing seeds the second year



Eradication and restoration simultaneously
Suitable for Himalayan balsam.

Description:

Mow the plants at least two times the first year. The plant material can be left on the site. After mowing the first time the second year, sprinkle the seeds out. Use plentiful of seeds to increase the chance of seeds to germinate.

Himalayan balsam is allelopathic so chose durable species for sowing.

Benefits:

Restoration is done at the same time as eradication is ongoing. The natural species will help decrease the spreading of the invasive alien species.

Disadvantage:

The seeds can need watering if the summer is dry.

Himalayan balsam is allelopathic and can reduce the germination of seeds of native species.

Economics:

Material needed: Seeds

2.3.9 Interesting methods that has not been used by the project

Method: Grazing

Suitable for Himalayan balsam, Giant hogweed, small amounts of lupiness

Description:

Grazing effectively eradicates many invasive plant species from a site and at the same time benefit grazing-dependent meadow species.

Sheep as grazing animals are common in Finland and Sweden, but other animals such as cows, goats and pigs have been used[7].

Benefits:

Having grazing animals present in a restoration area situated in a city or where people frequently visit usually attract visitors to the site, which can then be used to positively communicate about the restoration and IAS eradication effort.

Disadvantage:

Grazing needs to be maintained for many years. The animals need daily checkups (regulated by law) and access to fresh water. Make sure the animals are not spreading the invasive species when moved to a new location (seeds can be stuck in their fur and hooves for example).

Economics:

Material needed: Animals, fencing material, labor for daily care

Method: Habitat/ecosystem "hotel"

Suitable when endangered plant species need to be moved to be saved before eradication.

Description:

Ecosystem hotel[8] approach means moving endangered or valuable plant species to another site for some time because of construction or other measures that might destroy the species, to then be transferred back to the site when the conditions are suitable. Ecosystem hotels are usually in large infrastructure projects, such as roadbuilding.

Benefits:

This may help to increase the chances of survival of focus native species from "heavier" eradication and restoration methods.

---

[7] Metodkatalog

[8] https://helda.helsinki.fi/server/api/core/bitstreams/85ec3541-df5d-4f7f-98b0-028f6388d71f/content

Disadvantage:

May be costly, and not even many restoration entrepreneurs are equipped or have the facilities available to provide this service.

Economics:

Not known

Local perspective in restoration

Before choosing species that benefit the restoration process of the habitat, make sure you have all the data you need from doing surveys on the site. For instance, if you are restoring a dry meadow where the soil has become too nutrient-rich, you might consider planting plants and monitor the soil nutrient levels, before attempting to revegetate the site with meadow plant species with low nutrient level demand.

There are numerous commercial seed mixes for different habitat types available for purchase in Finland and Sweden. Always aim to choose seeds and ready-made seed mix products that are collected and made as close as possible from the project site.

AVOID IMPORTED SEED PRODUCTS BECAUSE:

1. Imported seeds, even though from the same species that is native to the project site, are genetically of a different genome strain that has acclimated to a different environment and climate.
2. Imported seeds or mixes can contain seeds or other propagules of invasive plant species growing as a contaminant weed in the same field. For example, there is evidence that Barnyardgrass (Echinochloa grus-galli), an especially harmful agricultural weed from imported seed mixes, has invaded areas in Finland.

There are several seed producers that can help design special seed mixes suitable for your specific area. It can be a bit more costly to gain these custom-made mixes but the risk of introducing a new species will be low. The species mix used in Västerbotten, Sweden, can be found in appendix 1.

3. Summary of restoration testing results from INSPIRE project

The INSPIRE project members Economic Development Centre for South Ostrobothnia (henceforward EDC for South Ostrobothnia), Västerbotten County Administrative Board (henceforward Länsstyrelsen) and City of Vaasa (henceforward Vaasa) did field experiments for nature restoration methods during summers 2024 to 2026. In total, 22 active, and five passive methods were tested for its effectiveness (see table 4). Some methods included eradication measures combined with restoration measures, and some consisted of restoration measures after eradication was finished. We also carried out traditional eradication methods to study the process of natural restoration. The targeted invasive alien species were Himalayan balsam, Japanese rose and Garden lupines.

Here are the most important findings from our tests:

- ***Fast restoration prevents erosion in Himalayan balsam-invaded steep slopes***

When the Himalayan balsam-slope was covered for two years, and then replanted with plug plants combined with seeds, we witnessed very good result. The slope was covered with the planted species in only two months, and no Himalayan balsam plants were observed. The following year we could see that the vegetation had established properly and only a couple of plants of Himalayan balsam was observed.

- ***Passive restoration often good enough when eradicating Himalayan balsam***

Passive restoration begins as soon as eradication measures begin. The test sites where Himalayan balsam were removed showed particularly good recovery response without any active restoration measures. We found that surrounding native species recolonized the test plots after only one year of eradication measures (with two or three eradication occasions per season). This can also be seen in the ordinary eradication work that the project organizations carry out.

We see this as a positive and encouraging signal to restoration or invasive alien species managers to lower their threshold to start removing invasive alien species – the restoration process begins immediately! Furthermore, we would strongly encourage in IAS eradication sites to at least to some extent monitor the changes in IAS and native species cover to see if the chosen methods are effective at that site.

- ***Adding seeds the second year of eradication can strengthen restoration in Himalayan balsam-invaded areas***

In the small test plots, the results showed that adding seeds after the second year of eradication worked just as well as adding seeds during both the first and second eradication measure. Seeds are expensive and therefore it will be more cost-efficient to only add seeds the second year.

This should only be prioritized if it is important to have fast recovery of certain species in the area, otherwise passive restoration works good enough.

- ***Combined eradication with cover and restoration with seeds successful for Garden lupines***

Covering Garden lupines with double folded, densely woven hessian/jute combined with 10 cm och soil, and then adding seeds from native species was shown to be a very good method to eradicate and restore a lupine-effected area. No lupine plants had grown through the cover layers during the test period.

From the small test plots, we could also see that restoration measures such as replanting and adding seeds worked well after lupine plants had been removed by digging.

- ***Combined eradication and restoration important for remote areas***

In remote areas, or in areas with visiting regulations, combined eradication and restoration will make the process to a restored area both time- and costefficient. Islands, or areas with bird protection regulations are examples of such areas.

Covering Japanese rose with hessian/jute is a method that Länsstyrelsen Västerbotten has used for many years. It begins to decompose after approximately three years and by then the rose is eradicated. The passive restoration begins as the decomposition starts but it takes many years for the area to be fully restored.

Cutting holes in the hessian/jute after one year and plant native species seems to be a successful method for faster restoration, but we only have results after one year of planting. This could also be worth testing for lupines in remote areas, as they otherwise need at least three to four eradication occasions for successful and permanent removal.

Prerequisites for interpreting the results:

The location, number of sites and replicas are not applicable to scientific studies. Länsstyrelsen and City of Vaasa adapted to existing needs within the mandatory management of invasive alien species. EDC don´t have any responsibilities as landowners and they chose the test sites in dialogue with landowners. Therefore, the test sites have been differing from cultural

meadows, coastal, forest edges and man-made green infrastructure such as noise and flood barriers and traffic intersections.

At most test site, we added control and treatment plots where we monitored and documented the change in target IAS cover percentage, and the number of native species and their cover percentage. Some species groups were grouped into one, for example Poaceae and some Asteraceae.

Eradication and nature restoration are time-consuming processes, and results are usually reached after many years of work. INSPIRE only lasted for three years and that must be taken into consideration when analyzing the results. The process to complete eradication usually takes at least 4 years followed by few years of follow-up monitoring. However, the results we received from our testing were promising, and we feal confident to pin out some methods that have the best probability to give best end results.

Länsstyrelsen only tested active restoration methods, primarily focusing on methods that combined eradication with restoration, with a few exceptions. Vaasa also tested active restoration methods. EDC for South Ostrobothnia mainly focused on passive restoration methods, in addition to two active restoration methods with native seeds from the site.

Table 4. Summary of methods tested in the INSPIRE project and it´s results.

Species	Site description	Passive/ Active	Eradication method	Restoration method	Results	Organisation
Garden lupin	Ruderal land	Active	Cover jute	10 cm soil, seeds	No lupins grow through the cover after three years; seed species have established	Länsstyrelsen Västerbotten
Garden lupine	Meadow	Active	Digging	Replanting	No lupins after one season where we planted native species	Länsstyrelsen Västerbotten
Garden lupine	Ruderal land / Meadow	Active	Digging	Seeds	Lupine cover was reduced from 50 % to 5 % and native species number (from 3 to 9) and cover percentage increased.	Länsstyrelsen Västerbotten
Garden lupine	Ruderal land / Meadow	Active	Digging	Replanting	Lupine cover was reduced from 55 % to 15 % and native species number (from 5 to 7) and cover percentage increased.	Länsstyrelsen Västerbotten
Garden lupine	Ruderal land / Meadow	Active	Terracut	Seeds	Lupine cover was reduced from 50 % to 30 % and native species number (from 3 to 11) and cover percentage increased.	Länsstyrelsen Västerbotten
Garden lupine	Ruderal land / Meadow	Active	Terracut	Replanting	Lupine cover was reduced from 70 % to 50 % and native species number (from 5 to 9) and cover percentage increased.	Länsstyrelsen Västerbotten
Himalayan Balsam	Steep slope	Active	Cover	Plug plants and seeds	After two years, the slope was still flourishing, and the risk of erosion gone. Only a couple of Himalayan balsam plants observed in the slope.	Länsstyrelsen Västerbotten
Himalayan Balsam	Meadow	Active	Clearing	Seeds first and second year	Himalayan balsam cover was reduced from 70-90 % to 0-1 % and native species number (from 4-5 to 8-10) and cover percentage increased.	Länsstyrelsen Västerbotten
Himalayan Balsam	Meadow, ruderal land, forest edge	Active	Root pulling	Seeds first and second year	Himalayan balsam cover was reduced from 75-90 % to 0-2 % and native species number (from 4 to 8-9) and cover percentage increased (from Länsstyrelsen test sites).	Länsstyrelsen Västerbotten, Vaasa
Himalayan Balsam	Meadow	Active	Clearing	Seeds second year	Himalayan balsam cover was reduced from 70-90 % to 0-4 % and native species number (from 2-4 to 6-9) and cover percentage increased.	Länsstyrelsen Västerbotten
Himalayan Balsam	Meadow	Active	Root pulling	Seeds second year	Himalayan balsam cover was reduced from 75-97 % to 0-1 % and native species number (from 2-3 to 6-10) and cover percentage increased.	Länsstyrelsen Västerbotten
Japanese rose	Coastal meadow	Active	Digging	Seeds first and second year	Japanese rose cover was reduced from 80 % to 20 % and native species number (from 4 to 12) and cover percentage increased.	Länsstyrelsen Västerbotten
Japanese rose	Coastal meadow	Active	Digging	Replanting	Japanese rose cover was reduced from 50 % to 2 % and native species number (from 3 to 11) and cover percentage increased.	Länsstyrelsen Västerbotten
Japanese rose	Coastal meadow	Active	Exhaustion	Seeds first and second year	Japanese rose cover was reduced from 50 % to 20 % and native species number (from 4 to 10) and cover percentage increased.	Länsstyrelsen Västerbotten

Species	Site description	Passive/ Active	Eradication method	Restoration method	Results	Organisation
Japanese rose	Coastal meadow	Active	Cover jute	Replanting	No roses grow through the holes that we cut through the cover. Native species has established.	Länsstyrelsen Västerbotten
Himalayan balsam	Ruderal land, forest edge	Passive	Root pulling	Natural restoration	Himalayan balsam cover was reduced from 60-90 % to 0-1 % and native species number (3 to 8) and cover percentage increased.	EDC for South Ostrobothnia
Himalayan balsam	Ruderal land, forest edge	Passive	Cutting	Natural restoration	Himalayan balsam cover was reduced from 40-95 % to 0-8 % and native species number (0-2 to 5-7) and cover percentage increased.	EDC for South Ostrobothnia
Himalayan balsam	Ruderal land, forest edge	Passive	Cover first year	Natural restoration	Himalayan balsam cover was only reduced from 95 % to 15 %, but native species number (0 to 6) and cover percentage increased.	EDC for South Ostrobothnia
Himalayan balsam	Noise barrier, cultural meadow	Active	Cutting, root pulling and covering	Seeds from site	Himalayan balsam cover was reduced from 50-100 % to 0-10 % and native species number (0-2 to 3-11) and cover percentage increased.	EDC for South Ostrobothnia
Garden lupine	Noise barrier, cultural meadow	Passive	Cutting	Natural restoration	Lupine cover was reduced in one but increased in another area. Still, native species number (1-2 to 5-8) and cover percentage increased in both areas due to eradication efforts.	EDC for South Ostrobothnia
Garden lupine	Noise barrier, cultural meadow	Passive	Cover first year	Natural restoration	Lupine cover was reduced from 95-90 % to 0-1 % and native species number (1-2 to 5-8) and cover percentage increased.	EDC for South Ostrobothnia
Garden lupine	Noise barrier, cultural meadow	Active	Cutting, digging and covering	Seeds from site	Lupine cover was reduced from 30-80 % to 0-10 % and native species number (1-2 to 4-10) and cover percentage increased.	EDC for South Ostrobothnia
Japanese rose	Beach shore	Active	Digging roots and trimming regrowth	Seeds first and second year	Trimming new growth of Japanese rose has reduced the coverage, replanted species have established.	Vaasa
Japanese rose	Roadside	Active	Digging and cover	Seeds first and second year	Covering is not worth the effort if the root system is dug out, new shoots rise around the cover. Maybe need larger cover area.	Vaasa
Himalayan balsam	Wet meadow	Active	Cover with lake reed	Seeds first and second year	Not Plants regrow from under the lakereed bed and the seed species from surrounding areas have mildly established.	Vaasa
Garden lupine	Roadside	Active	Digging and cover. Cutting maintenance	Seeds first and second year	Covering works with lupine and no new sprouts in covered area after 2 years of cover. Clear difference to control area next to it, where lupins still thrive and require further eradication.	Vaasa

4. Examples of restoration projects

Examples of (successful) restoration projects/methods

1. Combined eradication and active restoration in bird protection area

Japanese rose on Malgrundkallen, Holmöarnas nature reserve, Västerbottens county

2. Active restoration of a steep slope

Himalayan balsam at the church of Kusmark, Västerbottens county

3. Combined eradication and passive restoration in riverside meadow

Himalayan balsam and Hedge bindweed in Alakylä, Kauhava, South Ostrobothnia region, Finland

4. Active restoration in a pasture

Garden lupine in Sammalsuonpelto, Kouvola, Finland

5. Passive restoration after covering of Japanese rose – a summary

1. Combined eradication and active restoration in bird protection area

Japanese rose (*Rosa rugosa*) on Malgrundkallen, Holmöarnas nature reserve, Västerbotten county, Sweden





The habitat: Malgrundkallen is a small island within Holmöarnas nature reserve in the county of Västerbotten, Sweden. It is an important bird nesting island and here you can find terns (*Sterninae sp.*), gulls (*Larinae sp.*) and occasionally some black guillemots (*Cepphus grylle*). One of the most sensitive, and red listed species, nesting on the island is the lesser black-backed gull (*Larus fuscus*). Due to its importance for birds, the island is prohibited to entry between 15th of April to 15th of August.

The problem: Japanese rose (*Rosa rugosa*) had invaded the island and particularly one patch had grown to the size of almost 200 m^2. It was dense and hardly any other species was growing within the stand. There was nothing limiting the rose expansion except water, and it would continue to spread if left alone.

The restoration method: Due to the bird protection regulation, and the limited time to work, a method with combined eradication and restoration, was used. The first year, rose bushes were cut down with a clearing saw and then covered with densely woven, double folded hessian/jute.

The second year, small holes were cut in the hessian, and native plants were planted within the holes. The holes were then carefully covered so no sunlight would reach the ground underneath the hessian. Japanese rose must not reach any sunlight, otherwise it will continue to grow and eventually grow through the hessian.

The results: No rose shoots had managed to growth through the holes that we had made for planting the native species in. The planted individuals had survived and all of them seemed to have flowered or were in bloom when we visited the island.

Many native species had also established next to stones used for anchoring on the part that had been covered for two years. This shows that passive restoration will proceed, but the active restoration can shorten the time for the area to be fully restored.

Lessons learned: Eradication combined with restoration in September causes no disturbance to nesting birds. They probably don´t use the covered area for nesting during the first years, but the hessian/jute will decompose within 3-4 years. The passive restoration that will come automatically as the decomposition occurs, combined with active restoration with the replanted plants, will restore the area faster.

2. Active restoration of a steep slope

Himalayan balsam *(Impatiens glandulifera)* at the church of Kusmark, Västerbottens län, Sweden





The habitat: The church of Kusmark is located on a plateau, surrounded by the Kåge river to the south, and a small creek to the north and east. The slopes leading to the creek and towards the river, are steep and hazardous to walk in.
The slope that was to be restored was located at the top of the creek, when entering the church area.

The problem: When Himalayan balsam invades steep slopes, the risk of soil erosion increase as the species is annual (only live for one season) and therefore leaves the soil bare throughout the non-vegetation period. The climate change also increases the risk of erosion as heavy rainfalls will be more frequent.

Himalayan balsam grows in large parts of the slopes at Kusmark church surroundings. Erosion could eventually threaten the graveyard area.

The restoration method: Eradication of Himalayan balsam is usually not a big issue, but slopes are difficult as it can be hazardous to move around in them. Covering can be a good eradication method for these kinds of areas, but the problem is that when the cover is removed, the slope is highly exposed to erosion. Therefore, the goal was to reestablish the vegetation as fast as possible and decrease the amount of bare ground to a minimum. The same day as the cover was removed, approximately 2600 plug plants (93 cm3 pots) were planted and seeds added (see appendix 1 for species). Approximately 400 plants were left for the graveyard management staff to use for completion.

Division of species: *Silene vulgaris* 320 plugs, *Achillea millefolium* 320 plugs, *Leucanthemum vulgare* 360 plugs, *Potentilla crantzii* 400 plugs, *Ranunculus acris* 320 plugs, *Silene dioica* 320 plugs, *Knautia arvensis* 360 plugs, and *Geranium sylvaticum* 600 plugs.
The slope was watered whenever needed, depending on the rainfall.

The results: The restoration took place 10th of June 2025 and in august the same year, the slope was completely revegetated. The vegetation remained intact over winter and in summer 2026 the slope was green and flourished. The species composition had changed a bit, with a little less of the meadow species we had planted. That was expected as these species demand more nutrientpoor soil. The risk of erosion is now small.

Lessons learned: Plugplants made the restoration go much faster and probably made the slope more robust. The root system of all plug plants had time to stabilize the soil to a greater extent than the seed plants.
The staff at the church management department watered the slope whenever needed and made sure that they could establish properly. They were also left with some extra plug plants and could plant them if they noticed a gap in the slope.



3. Combined eradication and passive restoration in riverside meadow

Himalayan balsam and Hedge bindweed in Alakylä, Kauhava, South Ostrobothnia region, Finland



The habitat: The site is a sporadically flooded riverside meadow of 0,4 ha (a cultural habitat) along the Kauhava river.

The problem: The meadow was severely invaded by Himalayan balsam and Hedge bindweed (*Convolvulus sepium*). The goal was to remove the invasi-

ve species and allow natural restoration of the habitat, improve landscape values and remove excess of nutrients from the topsoil. The work was started in 2022 as part of Finnish Helmi Habitats programme.

The restoration method: The main invasive species removal method was grazing by sheep (June-August). To help the meadow species along, also some larger deciduous trees were removed before grazing to open the landscape and allow more sunlight. To minimize the risk of erosion, strong-rooted birches were left to bind topsoil in place. Additionally, the plant species that were left alone by sheep were cut to help make room for meadow-specific plant species.

The results: By the end of summer 2023, the presence of Himalayan balsam had already drastically fallen due to grazing, The grazing has continued also during 2024-2025, which have made sure that Himalayan balsam can't produce new seeds and that the existing seed bank will deplete. Hedge bindweed is still present and will require monitoring to prevent it from reinvading the forming meadow habitat.

Lessons learned: Grazing is an effective eradication method for invasive Himalayan balsam and has been in growing use in Finland. Grazing also provides more favourable conditions for the dispersal or return of more native species that favour cultural meadow or pasture -type habitats. What has been missing is long-term monitoring for change in the number and cover of alien and native species. Monitoring would be valuable to learn when the invasive species has been fully eradicated (resource management) and the native species composition has been restored.

4. Grazing as a restoration method for a pasture habitat invaded by Garden lupine

Sammalsuonpelto, Kouvola, Finland

The habitat: Sammalsuonpelto, a 7,1 hectare Natura 2000-site, is former farmland that now supports an endangered butterfly species, Scarce fritillary (*Euphydryas maturna*). Along the ditches and field margins are willow thickets and deciduous trees, which have been cleared away periodically. The area is managed by Metsähallitus (Forest Service).

The problem: The field itself and an access road leading to it has been invaded by Garden lupine. If left unchecked, the lupine would eventually invade and outcompete the critical host plants for the Scarce fritillary.

The restoration method: To keep the area open and maintain favorable conditions for the endangered butterfly, a sheep grazing area for 6,2 ha was established and grazing was maintained for a long period of time (2017-2024). In 2026 the area is being used as pasture for horses, that incidentally do not have a taste for lupines. Isolated lupines that were not eaten by sheep were removed manually and lupines outside the fence mowed periodically to prevent new seed set.

The results: Grazing has kept lupine at bay, but there was a minor setback in 2025 when individual lupines reappeared on the field due to a gap year in grazing activities. The lupines were removed by hand. What was originally a lupine monoculture is now only producing individual lupines here and there. Monitoring is ongoing on both the pasture and the access road.

Lessons learned: Grazing by sheep is an effective method to eradicate even an effective spreading species as lupines, where the sheep eat the lupines before they are able to produce more seed. After 8 years of grazing, the cover of lupines has decreased from almost 100 % to only a few scattered individuals here and there. This result has been possible due to good planning, adaptive management approach and reserving enough resources to see the plan through.

5. Passive restoration after covering of Japanese rose – a summary

Covering as an eradication method is very effective but causes high impact on the ground. After removal of the cover, all vegetation is usually gone. Restoration measures can be needed but our experience is that the recovery of the habitat usually works well by itself, as the seed bank is still viable. Also, the inflow of species from nearby also helps with the passive restoration. Here are three areas were Länsstyrelsen Västerbotten have documented the passive restoration after the cover was removed.

1. Japanese rose on Holmön, Umeå. Covered with tarpaulin 2020, removed 2023. Result from august 2025



2. Japanese rose on Holmön, Umeå. Cover with jute 2020, removed 2023. Result from august 2025



3. Långroudden, Kronören-Drivören, Nordmaling. Cover with tarpaulin in 2022, removed in 2025. Result from august 2026







Attatchment 1.

Plug plants and seed mix used in Västerbotten, Sweden

Plugg plant species composition

Swedish	Latin
Fyrkantig johannesört	*Hypericum maculatum*
Gullris	*Solidago virgaurea*
Midsommarblomster	*Geranium sylvaticum*
Prästkrage	*Leucanthemum vulgare*
Rödblära	*Silene dioica*
Rölleka	*Achillea millefolium*
Smällglim	*Silene vulgaris*
Smörblomma	*Ranunculus acris*
Vårfingerört	*Potentilla crantzii*
Åkervädd	*Knautia arvensis*

Seed species composition

Swedish	Latin
Fyrkantig johannesört	*Hypericum maculatum*
Gullris	*Solidago virgaurea*
Liten blåklocka	*Campanula rotundifolia*
Midsommarblomster	*Geranium sylvaticum*
Prästkrage	*Leucanthemum vulgare*
Rödblära	*Silene dioica*
Rölleka	*Achillea millefolium*
Smällglim	*Silene vulgaris*
Smörblomma	*Ranunculus acris*
Vårfingerört	*Potentilla crantzii*
Åkervädd	*Knautia arvensis*
Ängsklocka	*Campanula patula*
Fårsvingel	*Festuca ovina*
Rödven	*Agrostis capillaris*
Kruståtel	*Avenella flexuosa*

Attatchment 2.
The INSPIRE project

INSPIRE (Invasive Species: Information, Restoration and Engagement, 2024-2026) is a cross-border (Finland and Sweden) cooperation project that aims to stop the spread and increase the removal of invasive species in Finland and Sweden. INSPIRE is partially funded by INTERREG AURORA-program, which encourages cross-border action and collaboration in the Northern parts of Finland, Sweden and Norway. The lead coordinating partner is Etelä-Pohjanmaan Elinvoimakeskus (/ Economic Development Centre for South Ostrobothnia / Livskraftscentralen i Södra Österbotten). Other partners are Länsstyrelsen Västerbotten and Umeå municipality from Sweden and the City of Vaasa from Finland.

INSPIRE has three main goals formed into work packages (WP):

WP 1: working with the garden and green sectors to increase awareness and promote information to professionals and garden enthusiasts on how to prevent or minimize the risk of spread of invasive alien species. Main output will be a list of alien plant species of high risk due to high invasiveness potential and ecological effect, and safe alternative plant species to use in their stead.

WP 2: A strategy for restoration of habitats invaded by invasive alien species will be published, containing results from field tests of most cost-effective combinations of habitat restoration and invasive species removal methods. Umeå and Vaasa will also publish an extensive guideline for invasive species work for municipality use.

WP 3: Engaging local groups and municipalities to long-term IAS management activities.

Attatchment 3.
Glossary

Alien species
Alien species are animals, plants and other organisms or their seeds or other propagules that are introduced by human intervention accidentally or deliberately into a natural environment where they are not normally found.

Allelopathy
A form of plant interference, where one plant species affects the germination or growth of another by releasing chemical substances directly to the soil or indirectly through fallen detritus.

Ecosystem
The complex of living organisms, their physical environment, and all their interrelationships in a particular area or unit of space.

Ecosystem restoration
Assisting in the recovery of ecosystems that have been degraded or destroyed, as well as conserving the ecosystems that are still intact.

Ecosystem service
Benefits to human societies, that come from the organic or inorganic parts of well-functioning ecosystem. The benefits may be direct (food production, pollination, timber and fiber) or indirect, such as air and water purification or control of extreme weather and floods.

Habitat
The natural environment in which an organism or a population lives or grows and meets its environmental needs.

Habitat restoration
The process of assisting or repairing the ecological status of sites in nature whose biological communities and ecosystems have been degraded or destroyed

Invasive alien species (IAS)
Alien species, that cause or are known to be a risk causing serious negative consequences for their new environment on species or ecosystem level.

Range-expanding species

Species that move into a new area that they are not previously known to inhabit without human intervention by expanding its natural range, for example to further north due to climate change.

Propagule

Any structure of a plant (seed, spore, root, tubers, stem cuttings) used for reproduction or dispersal to a new site.

Terracut

A brushcutter-blade for soil scarification. On sandy soil the blade can sometimes reach the lupines growth point, and thereby eradicate the plant.



Aurora