

NBS Biodiversity interventions

This section presents **4 factsheets** devoted to **NBS Biodiversity Interventions**, shedding light on strategies for **conservation and restoration of fauna & flora**.

CONSERVATION AND RESTORATION OF FLORA

CARDIMED	INVASIVE ALIEN SPECIES CONTROL
<i>Picture not available.</i> Synonyms: management of invasive alien species; Clearing invasive alien trees. Description: Invasive alien species control involves the strategic management and mitigation efforts aimed at reducing or eradicating invasive species within an ecosystem or habitat. These invasive species, comprising non-native organisms such as plants, animals, or microorganisms, pose significant threats upon introduction to new environments. They can outcompete native species, disrupt ecological balance, and adversely affect the environment, economy, or human health. Removal of invasive species is a crucial conservation and environmental management practice, essential for maintaining the health and resilience of natural ecosystems while safeguarding native species from the impacts of invasive organisms. Such efforts are typically coordinated by governmental agencies, conservation organisations, and community groups.	
Main challenges targeted	Biodiversity & Renaturalization, Societal benefits
Regulation and Maintenance Services	Improve quality of surface water, Improve quality of groundwater, Efficient water treatment (effluent of WWTP), Reduce flood risk, Create or restore habitat, Restore degraded areas, Mitigate desertification, Create or restore fauna, Create or restore flora, Support pollination, Reduce harmful impacts to fauna & flora, Wetland creation and/or restoration, Forest creation and/or restoration, Connect green spaces, Connect blue and green spaces, Develop resilience of green spaces, Support free movement of species, Provide nesting and breeding habitat, Refuge for farm and wild animals, Restore natural forest fire regime, Coastal restoration & protection/ Promote resilience against natural disasters, Restore aquatic habitats, Stabilise soil / substrate, Improve soil fertility / biodiversity, Enhance and stabilise water retention, Improve carbon sequestration, Reduction of greenhouses gases emissions, Provide thermal regulation / cooling, Reduce risk of pest and diseases
Cultural Services	Nature appreciation, Health and Well-Being improvement, Increase recreational and socialisation value, Increase aesthetic and patrimonial or cultural value, Ensure accessibility to green spaces, Preserve cultural and historic heritage, Facilitate education, Reduce undesired behaviours, activities and vandalism, Support environmental awareness, Increase stakeholder engagement, Increase physical health, Promote mental health, Reconnect people with nature, Promote health habits
Provisioning Services	Improve soil fertility / biodiversity; Produce biochemicals, natural medicines and pharmaceuticals; Production of biomass; Provide raw material, Provide nutrition sources for birds and insects, Promote natural aquifer recharge / preserve groundwater supply, Promote natural surface water recharge / preserve surface water supply,

	Material reuse
Other Services	Contribute to local employment, Increase land/property monetary value, Increase tourism, Contribute to new or existing business, Reduced costs in comparison with other solutions, Favour green economy (reuse of local by-products)
Replicability	★★★☆☆
Design & planning	The design for controlling invasive species encompasses various methodologies: Biological control: This involves the application of natural enemies (biocontrol agents) by humans to manage pests or plants (target hosts), thereby reducing their populations by targeting invasive species. An example is the use of insects or pathogens to decrease or eradicate non-native invasive plants. Cultural control: This approach involves adopting practices to increase the mortality of invasives or reduce their rate of damage. Examples include selecting pest-resistant crops, utilising winter cover crops, and adjusting planting dates. Mechanical control: This method encompasses activities such as mowing, hoeing, tilling, girdling, chopping, and constructing barriers using tools or machinery to "harvest" invasive plants. This involves removing and collecting them, transporting them elsewhere, and allowing them to decompose. Physical or manual control: This strategy entails physical interventions such as hand-pulling, digging, flooding, drawdowns (de-watering), dredging, mulching, manual destruction or removal of nests, egg masses, or other life stages, as well as shading to manage invasive plants.
Operation and maintenance	Operational activities: Monitoring of the area where control measures have been applied to detect the presence of invasive species. This includes assessing the effectiveness of control measures, identifying any new invasive species, and adjusting control strategies in response to the effectiveness of implemented measures and changes in invasive species populations. Maintenance activities: Upkeep the infrastructure or interventions used for Invasive alien species control, such as replacing physical barriers, maintaining biocontrol agents, etc. Others: Training to staff and volunteers responsible for the operation and maintenance. Regular documentation of maintenance activities, operational issues, and measurements. Safety protocols and training (to prevent accidents and ensure compliance with safety regulations). Track legal and regulatory compliance. Be prepared to adapt your operation and maintenance practices over time in response to changing environmental conditions, market dynamics, and other factor
Combinations with other NBS	Restoring native vegetation, Reintroduction of native fauna, Green corridors and Riparian buffer (for reducing the pressure from invasive alien species, improving structure, composition and function of the ecosystem). Techniques for fauna refuge and nesting (woody debris or vegetation can be used to create habitat structures for

	wildlife or provide nesting sites for native species). Leaves, grass clippings, straw, or wood chips can be used for mulching application .
Supportive units & smart tech	GIS, computer vision and remote sensing (for detecting invasive species outbreaks in agricultural fields or natural habitats).
¹ CAPEX	<i>not available</i> . Main types of costs: Equipment and materials (trapping devices, drones, monitoring sensors, fencing, barriers, exclusion nets) Labour (clearing vegetation, establishing access roads and installing monitoring stations).
OPEX	<i>not available</i> . Main types of costs: Labour; Materials and supplies (traps, bait, protective gear, and monitoring equipment), Permits, fees and administrative (coordinating invasive alien species control programs, managing permits, regulatory compliance, administering outreach and public awareness campaigns); Research and development (Innovative approaches to invasive species control, develop new technologies or improve existing management techniques).
By-product(s):	Harvested organic biomass (for composting, organic fertilisers, biofuel production).

CARDIMED	RESTORING NATIVE VEGETATION
<i>Picture not available.</i> Synonyms: Reforestation; Afforestation; Planting Native Vegetation. Description: The restoration of native vegetation involves promoting natural regeneration and planting native plant species characteristics of the habitat to be restored, thus bringing the ecosystem back towards a good condition.	
Main challenges targeted	Biodiversity & Renaturalization, Societal benefits, freshwater and groundwater
Regulation and Maintenance Services	Air quality regulation, Climate regulation, Water regulation, Improve quality of surface water, Improve quality of groundwater, Avoid / reduce salinity in groundwater, Efficient water treatment (effluent of WWTP), Reduce flood risk, Reduce landslides, Permeability restoration, Create or restore habitat, Restore degraded areas, Mitigate desertification, Create or restore fauna, Create or restore flora, Support pollination, Reduce harmful impacts to fauna & flora, Wetland creation and/or restoration, Forest creation and/or restoration, Connect green spaces, Develop resilience of green spaces, Support free movement of species, Provide nesting and breeding habitat, Refuge for farm and wild animals, Increase green areas around urban rivers, Reduce sediment flow in the river, Restore natural forest fire regime, Coastal restoration & protection/ Promote resilience against natural disasters, Restore aquatic habitats, Reduce changes on soil characteristics, Stabilize soil / substrate, Improve soil fertility / biodiversity, Enhance and stabilize water retention,

¹ The researchers used a filtered version of the database, to assess costs incurred globally between 1960 and 2020. They report that over this period the total cost of damages from invasive alien species was €1,055.82 billion. The researchers highlight that the expenditure on management action for invasive species is 10 times lower than the cost of the damage they cause, and that the expenditure on preventive action is 25 times lower than on reactive measures. (European commission, 2022)

	Reduction of greenhouses gases emissions, Improve carbon sequestration, Provide thermal regulation / cooling, Reduce risk of pest and diseases, Provide genetic resources
Cultural Services	Recreation and ecotourism, Increase recreational and socialisation value, Increase aesthetic and patrimonial or cultural value, Preserve cultural and historic heritage, Facilitate education, Support environmental awareness, Health and Well-Being improvement, Ensure accessibility to green spaces, Increase stakeholder engagement, Enhance acoustic comfort, Promote mental health, Reconnect people with nature
Provisioning Services	Biochemical, natural medicines, pharmaceuticals, Fuel, Production of biomass, Provide raw material, Provide nutrition sources for birds and insects, Promote natural aquifer recharge / preserve groundwater supply, Promote natural surface water recharge / preserve surface water supply
Other Services	Contribute to local employment, Increase land/property monetary value, Increase tourism, Reduced costs in comparison with other solutions, Reduced carbon footprint
Replicability	★ ★ ★
Design & planning	Select variety of species and genetic variability. Seeds or cuttings are often collected from various sources within the local region to ensure genetic diversity, a crucial factor in fostering resilient ecosystems. Planting with seeds or seedlings. Planting methods may involve the direct sowing of seeds or the transplantation of seedlings, both aimed at re-establishing diverse and thriving native plant communities. Developing an irrigation plan in the early stages of planting to ensure the survival of seedlings. Planting in suitable environmental conditions (i.e., avoiding planting during drought months in Mediterranean climates). Considering ecological succession , initially planting pioneer species and, once established, introducing late successional species. Placing protective structures around planted seedlings to improve their chances of survival and natural perches to promote the dispersion of planted species.
Operation and maintenance	Operational activities: Installation of fencing, If soil preparation and soil moisture during planting were adequate, monitoring irrigation should not be necessary. Annual monitoring is essential to evaluate and identify the success of native vegetation restoration or determine if modifications are needed. In this sense a monitoring management plan should include specific measures aligned with the SMART principles (Specific, Measurable, Achievable, Realistic and Time-bound). Maintenance activities: Control of competing plants, and management of herbivores or other animals that may damage the plantations. Others: Training to staff and volunteers responsible for the operation and maintenance. Regular documentation of maintenance activities, operational issues, and measurements.Safety

	protocols and training (to prevent accidents and ensure compliance with safety regulations).Track legal and regulatory compliance.Be prepared to adapt your operation and maintenance practices over time in response to changing environmental conditions, market dynamics, and other factor
Combinations with other NBS	Invasive alien species control, Reintroduction of native fauna, Techniques for fauna refuge and nesting (for reducing the pressure from invasive species, improving structure, composition and function of the ecosystem). Riparian buffer and Green corridors (enabling native species to establish and adapt to their environment, improving structure, composition and function of the ecosystem). Leaves, grass clippings, straw, or wood chips can be used for Mulching applications . Properly composted organic biomass can also be used for Compost application .
Supportive units & smart tech	Remote sensing, computer vision and GIS (for prioritising intervention areas and monitoring the success of native species restoration practices).
CAPEX	<i>not available</i> . Main type of costs: Equipment and materials (seeds, seedlings or saplings, fencing, tree shelter, irrigation system, seed drills, planting machinery and irrigation equipment); Labour (land clearing, soil preparation, and erosion control measures construction, fencing and irrigation system installation and access roads construction).
OPEX	<i>not available</i> . Main type of costs: Labour (training staff, maintenance of seeds, seedlings, or saplings, watering, fertilising, pest control measures, weed control, invasive alien species management, data collection, analysis and reporting); Research and development (innovative approaches to invasive alien species control, develop new technologies or improve existing management techniques).
By-product(s):	Woody biomass and organic biomass from trimming, pruning, clippings and fallen leaves (for mulching, soil amendments, composting, organic fertilisers, energy production and biofuel). Potential generation for carbon credits.

CONSERVATION AND RESTORATION OF FAUNA

CARDIMED	TECHNIQUES FOR FAUNA REFUGE AND NESTING
<i>Picture not available.</i> Synonyms: Insect Hotel; Practices for enhancing wildlife habitat; Habitat structures for animal conservation. Description: Techniques for Fauna Refuge and nesting aim to bolster biodiversity and support habitat restoration efforts. This involves constructing hedgehog houses and rock piles to offer cosy shelters for small mammals and reptiles, while also creating insect hotels to attract and shelter various beneficial insects crucial for ecosystem health. Additionally, brush piles and artificial roosts provide cover and nesting sites for a variety of wildlife, while wildflower meadows attract insects and serve as habitat for a diverse array of plant species. Together, these interventions form a comprehensive strategy for promoting ecological balance and preserving biodiversity in our environment.	
Main challenges targeted	Biodiversity & renaturalization, Societal benefits

Regulation and Maintenance Services	Create or restore fauna, Support pollination, Support free movement of species, Provide nesting and breeding habitat, Refuge for farm and wild animals
Cultural Services	Recreation and ecotourism, Health and Well-Being improvement, Increase recreational and socialisation value, Facilitate education, Support social cohesion and justice, Support environmental awareness, Increase stakeholder engagement, Increase physical health, Promote mental health, Reconnect people with nature, Promote health habits
Provisioning Services	Provide nutrition sources for birds and insects
Other Services	Not available
Replicability	★ ★
Design & planning	Understanding the natural structures preferred by the target species involves either conducting well-designed experiments to assess the interaction between the target species and the proposed structures, or collaborating with experts in ecology and biology. It also requires closely observing the behavioural patterns and habitat preferences of the target species, including nesting preferences and shelter requirements. Additionally, it's crucial to evaluate whether the desired outcomes are achieved and make necessary adjustments accordingly. This ensures alignment with ecological principles and best practices.
Operation and maintenance	Operational activities: Monitoring and measuring durability and effectiveness of the structures. Detect possible negative outcomes (such as facilitating invasive insect species). Assessment and distribution of findings to more effectively inform conservation managers. Furthermore, regular monitoring and adaptive management are essential for ongoing success, allowing for adjustments based on observed outcomes and feedback from the target species. Following these guidelines ensures the creation of effective and sustainable habitat enhancements that contribute to biodiversity conservation and ecosystem preservation. Others: Training to staff and volunteers responsible for the operation and maintenance. Regular documentation of maintenance activities, operational issues, and measurements. Safety protocols and training (to prevent accidents and ensure compliance with safety regulations). Track legal and regulatory compliance. Be prepared to adapt your operation and maintenance practices over time in response to changing environmental conditions, market dynamics, and other factor
Combinations with other NBS	Restoring native vegetation, Invasive alien species control, Reintroduction of native fauna, Lagoon restoration, Agroforestry, Green corridors, Riparian buffer and Urban micro forest for providing a holistic approach to ensure safe habitats for wildlife reproduction and nesting, maintain and promote healthy populations of native species, and increase wildlife's ability to adapt to environmental and climate changes. Leftover wood scraps and sawdust generated during the

	fabrication of structures can be used for Mulching / Compost application .
Supportive units & smart tech	Smart sensors and computer vision incorporated into nesting boxes (for tracking occupancy, environmental conditions, and animal behaviour). Remote sensing and GIS (for prioritising intervention areas).
CAPEX	<i>not available</i> . Main type of costs: Equipment and materials (nesting boxes, bat boxes, hedgehog houses, rock piles, insect hotels, brush piles, artificial roosts, purchase of sensors, cameras, data loggers, and other monitoring devices); Technology and software (GIS and other software applications); Permits, fees and administrative; Labour.
OPEX	<i>not available</i> . Main type of costs: Labour (maintaining and repairing habitat structures, equipment and infrastructure); Permits, fees and administrative; Community engagement and educational programs.
By-product(s):	Leftover wood scraps and sawdust generated during the fabrication of structures for nesting and refuge (for mulching or composting). Soil may be displaced to create suitable habitats. This soil can be repurposed for landscaping or gardening.

<u>CARDIMED</u>	REINTRODUCTION OF NATIVE FAUNA
<i>Picture not available.</i> Synonyms: Species reintroduction; Wildlife reintroduction; Rewilding; Wildlife restoration; Species reintroduction; Reintroduction of wildlife; Reintroductions of fauna; Reintroductions of animals. Description: The reintroduction of native fauna is a deliberate process focused on returning animal species to their native habitats following extirpation or extinction in the wild. It often involves releasing individuals bred in captivity or captured from the wild, with the primary goal of revitalising wild populations and reinstating biodiversity in areas where species have vanished.	
Main challenges targeted	Biodiversity & renaturalization, Societal benefits
Regulation and Maintenance Services	Create or restore habitat, Restore degraded areas, Mitigate desertification, Create or restore fauna, Create or restore flora, Support pollination, Reduce harmful impacts to fauna & flora, Develop resilience of green spaces, Support free movement of species, Provide nesting and breeding habitat, Refuge for farm and wild animals, Increase green areas around urban rivers, Restore natural forest fire regime, Improve soil fertility / biodiversity, Enhance and stabilize water retention, Improve carbon sequestration, Reduce risk of pest and diseases
Cultural Services	Aesthetic values, Recreation and ecotourism
Provisioning Services	Provide nutrition sources for birds and insects, Nutrient recovery, Sustainable food production
Other Services	Contribute to local employment, Increase land/property monetary value, Increase tourism, Contribute to new or existing business, Reduced costs

	in comparison with other solutions, Favour green economy (reuse of local by-products)
Replicability	★ ★ ☆
Design & planning	Ensuring that habitat suitability and availability align with the requirements of selected species is essential for determining feasibility. Comprehensive understanding of any species for translocation must encompass its biotic and abiotic habitat requirements , its interspecific relationships, critical dependencies, and fundamental biological traits. The climate at the destination site should remain suitable for the future. In some instances, the original species or subspecies may have become extinct, both in the wild and in captivity. In such cases, a similar, related species or subspecies can serve as an ecological replacement, provided that the substitution is grounded in objective criteria such as phylogenetic closeness , resemblance in appearance, ecology, and behaviour to the extinct form. Conservation translocations should strive to adhere to internationally accepted standards for welfare . They must also comply with the legislation, regulations, and policies in both the source and release areas. Managing disease and preventing pathogen transfer is crucial. It aims to optimise the health of translocated organisms while minimising the risk of introducing new pathogens to the destination area.
Operation and maintenance	Operational activities: Monitoring and evaluation are crucial for identifying new threats to the translocated population that were not initially anticipated in the translocation design. The intensity and duration of monitoring for both the source and translocated populations should be tailored to each specific situation. Others: Training to staff and volunteers responsible for the operation and maintenance. Regular documentation of maintenance activities, operational issues, and measurements. Safety protocols and training (to prevent accidents and ensure compliance with safety regulations). Track legal and regulatory compliance. Be prepared to adapt your operation and maintenance practices over time in response to changing environmental conditions, market dynamics, and other factor
Combinations with other NBS	Techniques for fauna refuge and nesting, Lagoon restoration, Restoring native vegetation, Invasive alien species control (for promoting the restoration and conservation of natural habitats for native species, encouraging the reproduction and establishment of native species, and controlling populations of invasive species)
Supportive units & smart tech	GPS (to monitor the movements and behaviours of reintroduced animals in their natural habitats). Remote sensing (satellite imagery and aerial drones) and computer vision (to assess habitat suitability, monitor vegetation dynamics and identify potential threats to reintroduced species). Artificial intelligence and machine learning (to identify patterns, predict population trends, and optimise management strategies for better conservation outcomes).

CAPEX	<i>Not available.</i> Main type of costs: Equipment and materials (vehicles and equipment for transporting animals, tracking devices, GPS collars, cameras, and other monitoring systems and breeding and raising animals facilities); Research and development (feasibility studies and planning activities prior to reintroduction); Transportation and delivery; Labour (restoring or enhancing habitats and other tasks).
OPEX	<i>Not available.</i> Main type of costs: Labour (monitoring, data collection and veterinary care); Research and development.
By-product(s):	<i>Not applicable</i>