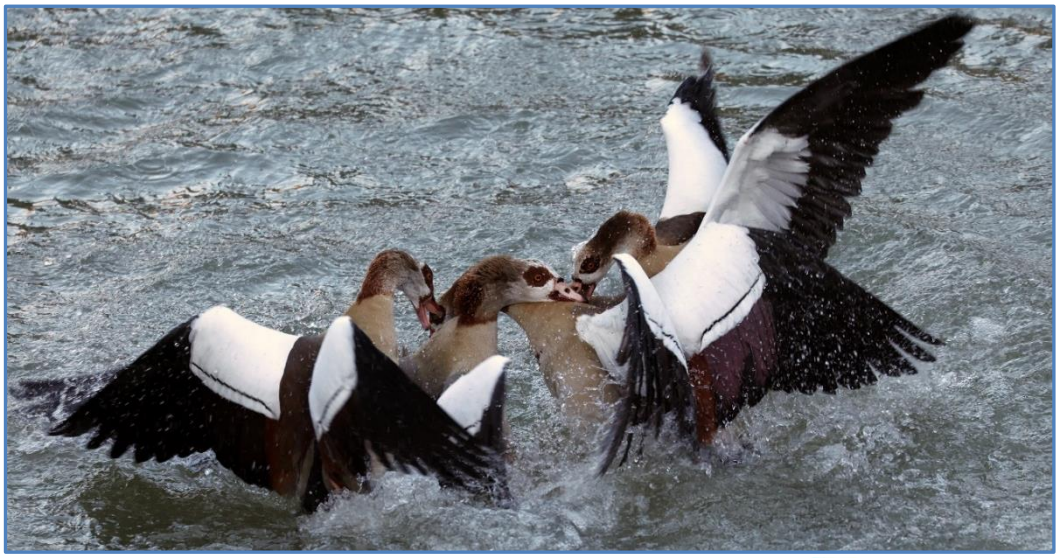
Action Plan

Reducing the impact of Invasive Alien Species on endangered species and habitats of Community interest (RedIAS)

Version 5.2 – 21/01/2025



Picture front page:

Fighting Egyptian geese (*Alopochen aegyptiaca*) in the Alzette river (13/01/2025)
Picture by Dr. Axel Hochkirch

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Summary

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1. Introduction

The goal of this action plan is to achieve the National Plan for Nature Conservation's (PNPN3) objective of reducing the number of red-listed species threatened by invasive alien species (IAS) by 50% and reducing the number of habitat types of Community Interest deteriorated by IAS by 50% by 2030 (MECDD 2023).

A key strategy to reduce the impact of Invasive Alien Species (IAS) on endangered species and habitats of Community interest involves several coordinated steps. This strategy combines prevention, early detection, rapid response, control, and public awareness to mitigate the negative effects of IAS on biodiversity.

The strategy is based on a status review of the endangered species and habitats as well as the IAS that affect them. Furthermore, the strategy defines goals, objectives that need to be met to achieve these goals, and actions that will accomplish the objectives. Targets and objectives need to be "SMART", which means **S**pecific, **M**easurable, **A**chievable, **R**ealistic, and **T**imebound.

Finally, the action plan addresses the practical issues of who, how, where and when as well as financing issues. Addressing the issue requires a long-term commitment, robust policy frameworks, and adaptive management, all of which must be reflected in the strategy.

The components of the strategy are the following:

- A **status review** of the current status of the impact of IAS on endangered species and habitats of Community interest. This status review also contains information on the current existing efforts to combat the risk of IAS.
- A long-term overarching **vision** of the desired status of species and habitats affected by IAS. This vision is informed by the National Plan for Nature Conservation (PNPN3), which has the goal to reduce the number of red-listed species threatened by invasive alien species (IAS) by 50%, and to reduce the number of habitat types of Community Interest deteriorated by IAS by 50% by 2030.
- The **goals** are practical, concrete steps that contribute to achieving the vision.
- A set of **objectives** needed to achieve the goals over the stated timespan.
- **Actions** to address each objective. Actions are the activities which need to be performed in order to achieve the objectives, and, ultimately, the goals. Recommendations for actions provide details of what needs to be done, where, when, and by whom.
- Determining the necessary **monitoring** to check the effectiveness of the implementation of the strategy.
- Good **coordination** of the various stakeholders and measures is essential to enable the strategy to be implemented efficiently. Therefore, establishing coordination is an essential element of the strategy.

For most threatened species and protected habitat types in Luxembourg, IAS represent just one of many threats and are often not the most significant. Factors such as direct habitat destruction, agricultural intensification, over-fertilization, climate change, pesticide use, landscape homogenization, and water pollution impact numerous species. Healthy ecosystems are more

resistant to invasions of non-native species, which needs to be considered during planning. This should also be considered in the context of the national obligation arising from European restoration law.

Although there are other groups of species that could be affected by IAS (e.g. algae and fungi), the strategy is limited to species for which we have information on their conservation status, i.e. either a Global, European or national Red List assessment.

In order to limit overlaps with the national strategy on Invasive Species (Nationale Strategie zu invasiven gebietsfremden Arten in Luxemburg – QUACK et al 2024), reference was made to this strategy in various objectives or actions.

2. Status review

2.1. Scope

This action plan is embedded in the National Plan for Nature Conservation (PNPN3) and addresses the target to reduce the number of red-listed species threatened by invasive alien species (IAS) by 50 %, and to reduce the number of habitat types of Community Interest deteriorated by IAS by 50% by 2030 ("50% target"). The status review provides the necessary information on the current status of biota, particularly information on the species that are currently considered threatened by invasive alien species. This information was gathered during the workshop "Quantifying the impact of invasive alien species on biodiversity" on the 17th of November 2023. During this workshop, the participants sorted all Red List species and pledged species/habitats into one of six categories regarding the impact of IAS: (1) definitely threatened by IAS, (2) probably threatened by IAS, (3) possibly threatened by IAS, (4) unknown, (5) probably not threatened by IAS, (6) definitely not threatened by IAS. Furthermore, the name of the impacting IAS was provided to allow prioritising certain IAS.

Information on plant species threatened by IAS is relatively scarce. However, there appear to be differences among habitats in the probability of invasions. These invaders are likely to act as competitors for light, nutrients and space. Ruderal and aquatic habitats appear to be least resistant to invasions of alien species, whereas the resistance is somewhat higher in forests, freshwater margins and rocky biotopes. Grasslands and wetlands appear to have the highest resistance against invasions (COLLING, G., personal communication, October 11, 2024). Using this information, the new Red List of Plants (COLLING et al, in prep.) was analysed for species that might be impacted by IAS.

The results of the workshop and the Red List analysis provide the baseline for planning to achieve the 50% target.

2.2. Baseline

To achieve the 50% target, IAS control must focus on the species identified for the first two categories, i.e. those which are (1) definitely threatened by IAS and those which are (2) probably threatened by IAS (tables 1-3). The choice of the 50% of species to be prioritised is ideally based upon synergetic effects, e.g. by focusing on species groups affected by the same IAS and/or occurring in the same habitat. The results show that aquatic species and habitats should be considered a priority to reach the above-mentioned target as they already comprise close to or more than 50% of the species and habitats threatened by IAS. Another important group to be considered in this context are ruderal plants (tables 1-3).

Table 1: Species and habitats defined as "definitely threatened by IAS" during the workshop (50% target: species and habitats chosen after the workshop as priorities of this strategy to reach the 50% target)

Threatened species	**Impacting IAS**	50% target
Aquatic plants on the red list	*Azolla filiculoides, Crassula helmsii, Elodea canadensis, Elodea nuttallii, Hippuris vulgaris, Hydrocharis morsus-ranae, Lemna minuta, Myriophyllum aquaticum, Nymphaea alba, Nymphoides peltata*	x
*Margaritifera margaritifera**	*Ondatra zibethicus*, *Procyon lotor*, *Pacifastacus leniusculus*, *Dreissena polymorpha*, *Dreissena bugensis*	x
Unio crassus	*O. zibethicus*, *P. lotor*, *P. leniusculus*, *D. polymorpha*, *D. bugensis*	x
*Austropotamobius torrentium**	*P. lotor*, *P. leniusculus*, *Aphanomyces astaci*	x
Astacus astacus	*P. lotor*, *P. leniusculus*, *A. astaci*	x
Neoascia unifasciata	*Reynoutria* sp., *Impatiens glandulifera*	x
Salamandra salamandra	*Batrachochytrium salamandrivorans (Bsal)*	x
Habitats	**Impacting IAS**	
3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation	*Azolla filiculoides, Crassula helmsii, Elodea canadensis, Elodea nuttallii, Hippuris vulgaris, Hydrocharis morsus-ranae, Lemna minuta, Myriophyllum aquaticum, Nymphaea alba, Nymphoides peltata*, *Reynoutria sp., I. glandulifera, Batrachochytrium dentrobatidis (Bd), Myocastor coypus, Ctenopharyngodon idella, Branta canadensis*	x
3260 Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation	*Reynoutria* sp., *I. glandulifera*, *Bd, Bsal, Ameiurus melas, Ameiurus nebulosus, Carassius gibelio, Lepomis gibbosus, Neogobius kessleri, Neogobius melanostomus, Oncorhynchus mykiss, Pseudorasbora parva, Sander lucioperca, Corbicula fluminalis, Corbicula fluminea, D. polymorpha, D. bugensis*	x
91E0 Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)	*Reynoutria sp., I. glandulifera, Impatiens parviflora, Cornus sericea*	x
6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	*Reynoutria sp., I. glandulifera, Helianthus tuberosus, Heracleum mantegazzianum*	x
9160 Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli	*Prunus serotina, Phytolacca americana, Prunus laurocerasus*	x
9180 Tilio-Acerion forests of slopes, screes and ravines	*Ophiostoma novo-ulmi* (DED), *Hymenoscyphus fraxineus* (Ash dieback), *Impatiens glandulifera, Mahonia aquifolium, Rhododendron ponticum*	x
Rocky habitats: 8150, 8160, 8210, 8220, 8230	*Ailanthus altissima, Buddleja davidii, Cerastium tomentosum, Cotoneaster sp., Fallopia baldschuanica, Lycium barbarum, Robinia pseudoacacia, Senecio inaequidens, Syringa vulgaris*	x

*: Regionally extinct

Note: In terms of a preventive approach, it is important to address the problem within forest areas now, even if it is not yet as acute as in other habitat types.

Table 2: Species and habitats probably threatened by IAS (50% target: species and habitats chosen after the workshop as priorities of this strategy to reach the 50% target)

Threatened species	**Impacting IAS**	**50% target**
Cottus gobio	*Neogobius sp., Ameiurus sp.*	x
Alytes obstetricans	*Bd, P. lotor*	x
Bombina variegata	*Bd, P. leniusculus*, Invasive aquatic plants, *P. lotor*	x
Hyla arborea	*Bd, P. leniusculus*, Invasive aquatic plants, *P. lotor*	x
Pelophylax esculentus	*Bd, P. leniusculus*, Invasive aquatic plants, *P. lotor*	x
Pelophylax lessonae	*Bd, P. leniusculus*, Invasive aquatic plants, *P. lotor*	x
Rana temporaria	*Bd, P. leniusculus*, Invasive aquatic plants, *P. lotor*	x
Triturus cristatus	*Bsal, P. leniusculus*, Invasive aquatic plants, *P. lotor*	x
Ixobrychus minutus	*Myocastor coypus*, *Alopochen aegyptiaca*, *B. canadensis*	x
Coenagrion mercuriale	*P. leniusculus*	x
Oxygastra curtisii	*P. leniusculus*	x
Habitats	**Impacting IAS**	
6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia)	*Bunias orientalis, Pinus nigra, Senecio inaequidens, Solidago* sp.*, Robinia pseudoacacia, Symphoricarpos* sp.*, Cotoneaster, Laburnum, Erigeron annuus*	

Table 3: Critically endangered plant species probably threatened by IAS (50% target: species chosen after the workshop as priorities of this strategy to reach the 50% target)

Taxon	Impacting IAS	50% target
Habitat type: Aquatic	*Azolla filiculoides, Crassula helmsii, Elodea canadensis, Elodea nuttallii, Hippuris vulgaris, Hydrocharis morsus-ranae, Lemna minuta, Myriophyllum aquaticum, Nymphaea alba, Nymphoides peltata*	x
Callitriche obtusangula		x
Ceratophyllum submersum		x
Groenlandia densa		x
Myriophyllum alterniflorum		x
Najas marina		x
Potamogeton lucens		x
Potamogeton obtusifolius		x
Vallisneria spiralis		x
Habitat type: Forest	*Castanea sativa, Impatiens parviflora, Picea abies, Pinus nigra, Prunus laurocerasus, Prunus serotina, Robinia pseudoacacia*	
Asarum europaeum		
Calamagrostis arundinacea		
Carex ornithopoda		
Carex umbrosa		
Circaea alpina		
Conopodium majus		
Dryopteris affinis subsp. cambrensis		
Epipactis leptochila		
Epipactis microphylla		
Epipogium aphyllum		
Fragaria moschata		
Lathyrus niger		
Lunaria rediviva		
Lycopodium annotinum		
Orobanche hederae		
Osmunda regalis		
Polystichum lonchitis		
Ranunculus platanifolius		
Habitat type: Ruderal areas	*Ailanthus altissima, Alnus incana, Ambrosia artemisiifolia, Buddleja davidii, Bunias orientalis, Datura stramonium, Helianthus tuberosus, Heracleum mantegazzianum, Lupinus polyphyllus, Medicago sativa L. subsp. sativa, Paulownia tomentosa, Reynoutria ×bohemica, Reynoutria japonica, Reynoutria sachalinensis, Rhus typhina, Senecio inaequidens, Senecio vernalis, Solidago canadensis, Solidago gigantea, Symphyotrichum lanceolatum, Symphyotrichum novi-belgii*	x
Chondrilla juncea		x
Crepis pulchra		x
Delphinium consolida		x
Filago arvensis		x
Gagea pratensis		x
Gagea villosa		x
Galium spurium		x
Hyoscyamus niger		x
Lactuca saligna		x
Linaria arvensis		x
Lysimachia minima		x
Orobanche minor		x
Orobanche picridis		x

Oxybasis rubra		x
Oxybasis urbica		x
Raphanus raphanistrum		x
Silene noctiflora		x
Stachys annua		x
Vaccaria hispanica		x
Veronica verna		x
Habitat type: Rocks	*Ailanthus altissima, Buddleja davidii, Cerastium tomentosum, Cotoneaster* sp.*, Fallopia baldschuanica, Lycium barbarum, Robinia pseudoacacia, Senecio inaequidens, Syringa vulgaris*	
Asplenium ×murbeckii		
Dianthus gratianopolitanus		
Fourraea alpina		
Galium boreale		
Verbascum pulverulentum		

Note: The initial establishment of alien aquatic plants is often due to aquarium plants that have been released into the wild. After that, the plants disperse mostly through vegetative (clonal) propagation by means of budding or fragmentation which enables the rapid formation of large stands. Vegetative propagation makes targeted control of the species even more difficult, as control measures often result in small fragments of the plants. This fact increases the risk of further spread. Other dispersal routes include transport by animals, e. g. in the plumage or intestines of waterfowl, and by humans (clothing and footwear, uncleaned work materials, fishing, etc.). The uncontrolled spread of aquatic IAS can quickly lead to highly competitive dominant stands, which are capable of displacing native species (OLY 2022).

Problematic IAS are *Azolla filiculoides, Crassula helmsii, Egeria densa, Elodea canadensis, Elodea nuttallii, Hydrocotyle ranunculoides, Lagarosiphon major, Lemna minuta, Ludwigia grandiflora, Ludwigia peploides, Lysichiton americanus, Myriophyllum aquaticum* and *Myriophyllum heterophyllum*. While some of these species are widely distributed in Luxembourg, others have been observed only once or twice, or not at all to date.

2.3. Existing governance

A wide range of stakeholders at national, regional, and local levels are involved in various aspects of managing IAS, including data collection, education, prevention, and implementation of control measures. However, the coordination of these efforts has often been criticised as insufficient or lacking. While there is some awareness of who is active in this field, there remains significant uncertainty about what actions are being taken, by whom, and where. As the challenges posed by the spread of established IAS and the emergence of new ones grow, an effective response is becoming increasingly difficult without proper information sharing and coordination.

The IAS Group Luxembourg (Groupe de coordination sur les espèces exotiques envahissantes au Luxembourg - GC EEE) was set up to support the development of national strategies for the prevention and management of invasive alien species. This national task force should oversee IAS management, policy development, and coordination. Its role is to ensure consistency and coherence across all levels of governance and give scientific advice. The group should also treat foreseeable problems (work on private grounds, elimination of green waste, animal protection issues, …).

Coordination is also essential at the international level. In the context of Luxembourg, cross-border cooperation is particularly crucial for managing species that disperse or are introduced through trade. This collaboration at the level of the Greater Region, therefore, must be strengthened.

The Natural History Museum maintains the national database on the occurrence of species and thus also of IAS (MNHNL 2000). This provides a good basis for early response and the implementation of management measures. What is still missing, however, is a database accessible to all relevant stakeholders in which the control measures can be entered in order to obtain an overview of who did what, when and where. For some of the stakeholders, such a database is being developed (cf. Missions nature/GeNa).

2.4. Existing Early Warning System

Elimination of emerging IAS needs an early detection followed by rapid and systematic eradication. In order to achieve this objective, it is necessary to inform those involved on the ground rapidly, to set up an effective warning system and to train teams capable of rapidly implementing the necessary measures. An initial alert system was set up by the National Museum of Natural History (MNHN) already in 2018 and has been further developed since then. All observations of invasive species identified as such in Luxembourg and entered in the national Recorder-LUX database (MNHN 2000) or into GBIF (Global Biodiversity Information Facility), and data transmitted by the 'iNaturalist' application are automatically transferred by e-mail to different members of the ministerial coordination group on invasive alien species, who then forward the information to those responsible for managing the species concerned. However, the system is currently including all neobiota regardless of their impact or status in Luxembourg.

2.5. Implementation of the IAS Regulation in Luxembourg

Regulation (EU) No 1143/2014 of the European parliament and of the council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species sets out rules to prevent, minimise and mitigate the adverse impact on biodiversity of the introduction and spread within the Union, both intentional and unintentional, of invasive alien species.

This results in the following obligations for Luxembourg, among others:

- take all necessary steps to prevent the unintentional introduction or spread, including, where applicable, by gross negligence, of IAS of Union concern,
- when there is evidence concerning the presence in, or imminent risk of introduction into its territory of an IAS, which is not included on the Union list but can be regarded as fulfilling the same criteria, immediately take emergency measures against that species,
- carry out a comprehensive analysis of the pathways of unintentional introduction and spread of IAS of Union concern in its territory, and identify the pathways which require priority action ('priority pathways') because of the volume of species or of the potential damage caused by the species entering the Union through those pathways,
- establish and implement one single action plan or a set of action plans to address the priority pathways identified,
- establish a surveillance system of IAS of Union concern, or include it in its existing system, which collects and records data on the occurrence in the environment of IAS by survey, monitoring or other procedures to prevent the spread of these species into or within the Union,
- notify the Commission, in writing, of the early detection of the introduction or presence of IAS of Union concern and inform the other Member States,
- apply eradication measures and notify those measures to the Commission and inform the other Member States,
- have in place effective management measures for those IAS of Union concern which it has found to be widely spread on its territory, so that their impact on biodiversity, the related ecosystem services, and, where applicable, on human health or the economy are minimised,
- carry out appropriate restoration measures to assist the recovery of an ecosystem that has been degraded, damaged, or destroyed by IAS of Union concern.

3. Vision

By 2030, the number of species and habitats threatened by Invasive Alien Species (IAS) is reduced by 50% compared to 2024. Luxembourg has an efficient management system in place to control and monitor the impact of invasive alien species on threatened biota. IAS do not pose a significant threat to the conservation of native species and habitats. Invasive species control is linked to a permanent monitoring of both threatened and invasive species and targeted action is conducted in priority areas to mitigate their impact. Our knowledge of the impact of IAS on threatened species as well as efficient control methods is increased. Authorities, land users, conservationists and the general public are aware of the threats caused by IAS and the native species affected by them and act accordingly.

Goal 1 Governance and Management

Governance established, providing leadership and efficient management secured for IAS control at priority sites, ensuring the implementation of the plan; IAS control integrated in other existing conservation plans; early warning and rapid response system established.

Objective 1.1 Governance

To establish a steering group and strengthen local, regional and international collaboration by 2025 in order to guide and facilitate implementation of the plan and review progress regularly.

Note: This objective is also part of the national strategy on invasive alien species (objective 9) (QUACK et al 2024).

Actions

1.1.1 Creation of a steering group

Purpose: Guide and ensure implementation of all actions
Note: The GC-EEE is already in place to coordinate IAS management in Luxembourg and has regular meetings, but it should be extended to include representatives of all relevant stakeholders (for example Adm. P&CH). Targeted meetings focusing on the implementation of the strategy are needed. Subgroups for specific subjects should be considered. The steering group has to make sure that the control of IAS gets the priority it deserves.
Linked actions: 1.1.2, 1.1.3
Who: GC-EEE (Lead: MECB, ANF)
By when: 2025
Indicator: At least two meetings per year
Resources required: Staff time

1.1.2 Appointment of regional and local IAS coordinators

Purpose: Local implementation of the strategy, communication with the steering group, reporting. Encourage regions sharing similar habitats (e.g., river basins or forested areas, COPILs) to collaborate on IAS management, even across national borders if necessary. This might involve sharing resources, joint monitoring programs, and collaborative control efforts (regional stakeholders).
Note: Regular reporting and exchange with GC-EEE.
How: Establish regional priority maps based on available data and the input of experts. Use tools like the Belgian RiparIAS. Feedback by stakeholders about implemented control measures is needed.
Linked actions: 1.1.1, 1.2.2
Who: COPILs, Stations biologiques, Flusspartnerschaften, ANF
By when: 2025
Indicator: List of regional / local coordinators available
Resources required: Staff time

1.1.3 Coordination in the Greater Region

Note: Cross-border cooperation is particularly crucial for managing species that disperse via transboundary watercourses, are introduced through trade or which are common in neighbouring countries but do not yet occur in Luxembourg. Exchange of information and cooperation with regard

to the implementation of management measures in neighbouring countries. Particularly important for IAS that have not yet been observed in Luxembourg (EEA 2012, RABITSCH et al. 2018). Regular meetings in the Greater Region already take place at a higher level, but collaboration is also needed at the lower administrative level.
How: E.g. within the framework of an Interreg or a Life project
Linked actions: 1.1.1, 1.2.3.
Who: MECB/GC-EEE, Subgroups Greater Region, Benelux
By when: 2026
Indicator: Meetings within the frame of the Greater Region and regular exchange of information
Resources required: Staff time, travel costs

Objective 1.2 Data management

To improve data exchange among stakeholders engaged in IAS control, monitoring and research by 2026 in order to facilitate spatial planning of IAS control measures.

Actions

1.2.1 Ensure efficient data management

Purpose: Facilitate early submission of biodiversity data (particularly IAS and priority species) to national biodiversity database (mdata)
Note: Data seems to be incomplete and is often submitted too late to ensure an efficient management
How: MECB to check regularly submission requirements of funded projects/consultants. Make the database more user friendly or use simple excel-sheets to transmit the relevant data to MNHN. Submit submission template with project approval. Send out a reminder at least once a year. Payment after data submission. Organize meeting with data specialists in MNHN, ANF, AGE, LIST.
Linked actions: 1.1.1
Who: MECB, MNHN database group, ANF, AGE, LIST
By when: 2026
Indicator: Datasets handed in vs relevant projects realised for or authorised by MECB, ANF and AGE
Resources required: Staff time

1.2.2 Using a geoportal for tracking IAS control and other conservation measures and make it available to all stakeholders

Purpose: All actors carrying out management measures should be able to obtain information on implemented and ongoing actions and to document their own actions centrally. This could be based on the ANF's 'Espaces naturels' database (GENA), for example.
Note: There is currently no overview of which control measures are being implemented when, where and by whom.
Linked actions: 1.1.2
Who: MECB, ANF
By when: 2026
Indicator: Existing database with relevant information available to all stakeholders
Resources required: Staff time, IT development or customisation of a database

1.2.3. Develop a tool for tracking IAS at the Greater Region level

Purpose: Facilitate data exchange and coordination of measures within the Greater Region
Linked actions: 1.1.3., 1.2.2
Who: Greater Region, MECB, ANF
By when: 2028
Indicator: Existing database with relevant information available to all stakeholders
Resources required: Staff time, IT development or customisation of a database (platform https://map.gis-gr.eu/)

Objective 1.3 Early warning system and rapid response

To improve existing early warning systems by 2025. Establish a standardised workflow by 2026 to allow a rapid response to eliminate emerging or problematic IAS. This objective is also part of the national strategy on invasive alien species (objective 4) (QUACK et al 2024).

1.3.1 Revise early warning system to focus on new or problematic IAS

Note: The current warning system is not specific enough. A warning system is only needed for species or in biodiversity hotspots where rapid action is required.
How: Establish a list of concerned species and experts.
Linked actions: 1.1.1, 1.1.3, 1.2.2, 1.3.2
Who: MNHN, GC EEE
By when: 2025
Indicator: Early warning system revised
Resources required: Staff time

1.3.2 Formalization of information transfer on new or problematic IAS

Purpose: Enable a fast, consistent and efficient response to the IAS occurrences reported by the early warning system. Establish a coordination point to achieve this.
Note: Is currently being implemented
How: Based on an organisation chart indicating the managers to contact for the various groups of species
Linked actions: 1.1.1, 1.1.3, 1.3.1
Who: ANF
By when: 2025
Indicator: Completed organisation chart/flowchart
Resources required: Staff time

1.3.3 Setting up and training teams capable of rapid implementation of necessary measures

Purpose: Immediately implement control measures after a report of new or very problematic IAS.
Note: Handbook for control measures for species not yet present in Luxembourg is needed
Linked actions: 1.1.1, 1.3.1, 1.3.2
Who: ANF, AGE, Stations biologiques, fishermen, hunters, municipalities
By when: 2026
Indicator: Training teams established
Resources required: Staff time, travel costs

1.3.4. Change authorisation procedure

Purpose: Reduce the administrative workload and ensure that measures can be implemented rapidly.
How: Issue a general/ multi-year authorisation for implementation of the strategy for actors involved. Adapt regulation. Control measures are generally allowed, annex with list of invasive species is currently being developed.
Linked actions: 1.1.1, 1.1.2
Who: MECB, ANF, AGE
By when: 2025
Resources required: Staff time

Objective 1.4 Integration in existing plans

To integrate all actions proposed in this plan into existing plans, such as habitat action plans, management plans of Nature 2000 areas and national protected areas (ZPIN), and plans under the water framework directive. The national action plan on emerging infectious diseasing affecting amphibians (STASSEN & LESTANG 2023) already covers this topic.

Actions

1.4.1 Ensure consideration of IAS management in Habitat Action Plans

Purpose: The necessary protection and management measures to maintain or improve the quality of the respective habitat type are specific and largely known. The aim here is to implement them rigorously and consider IAS control. One basis for the implementation of the necessary measures is the 'plans d'action habitats' of the Ministry of the Environment.
How: Review of habitat action plans
Linked actions: 1.1.1, 1.1.2, 2.1.1, 2.1.2, 2.1.3
Who: MECB
By when: 2027
Indicator: Report on consideration in management plans
Resources required: Staff time

1.4.2 Ensure consideration of IAS management in Natura 2000 and ZPIN management plans

Purpose: As some of the habitats threatened by IAS are specially protected in Natura 2000 areas, the implementation of control measures is particularly important here. This needs to be coordinated with other management measures in Natura 2000 areas. National nature protection areas are biodiversity hotspots. In these areas management of IAS is also of particular importance.
Note: This has already been partially implemented.
How: Review of management plans
Linked actions: 1.1.1, 1.1.2, 2.1.1, 2.1.2, 2.1.3
Who: GC-EEE, COPIL, MECB, ANF
By when: next revision of management plans
Indicator: Review of all management plans
Resources required: Staff time

1.4.3 Ensure and improve consideration of IAS in the management plans under the Water Framework Directive

Note: As aquatic species and habitats are a priority of this strategy, the management plan in the context of the WFD is of central importance for the implementation of targeted measures.
How: Review of management plans
Linked actions: 1.1.1, 1.1.2
Who: GC-EEE & AGE
By when: 2025
Indicator: Report on consideration in management plans
Resources required: Staff time

1.4.4. Include IAS management in the context of nature restoration law

Purpose: Make sure that IAS are considered when restoring ecosystems
Note: Nature restoration law was considered during elaboration of PNPN3.
How: Include the problems caused by IAS and the necessary prevention and control measures in the planning.
Linked actions: 1.1.1, 1.1.2, 2.1.6, 2.2.1, 2.2.2, 2.2.3, 2.2.4,
Who: MECB
By when: 2030
Indicator: Existing plans for ecosystem restoration consider IAS
Resources required: Staff time

Objective 1.5 Prevention

To improve prevention of intentional and unintentional introductions of IAS not yet present in Luxembourg and spread of IAS already present.

Actions

1.5.1 Implementation of the existing action plans in relation with prevention

Purpose: Efficient use of resources through the implementation of existing plans
Note: Update of the action plans is scheduled for 2025
How: The Ministry of the Environment has developed action plans on this issue, which need to be implemented (PFEIFFENSCHNEIDER & HOPPE 2021 a-d).
Linked actions: 1.1.1, 2.1.3, 2.3.1, 2.3.2, 5.1.1
Who: MECB, ANF, AGE, ASTA
By when: 2026
Indicator: Review of implementation of actions
Resources required: Staff time

1.5.2 Optimizing law enforcement on sale, transport and release of IAS

Purpose: Enforce existing laws that ban the sale, transport, and intentional release of known invasive species (Art. 25 loi PN national, Règlement (UE) No 1143/2014).
Note: Some species of EU concern can still be bought in Garden centres for example. This needs actions at least within the framework of the Greater Region: Raise awareness, inform (about alternatives cf. AlterIAS by EBL) and enforce laws.
Linked actions: 1.1.1, 1.1.2, 1.1.3

How: Visit Garden centres and inform them about IAS in their collections, especially about species of EU concern that they are legally prohibited from selling. Clearly explain the legal consequences of non-compliance if corrective action is not taken. Take legal action if necessary.
Who: MECB, Stations biologiques, ANF
By when: 2026
Indicator: No IAS of EU concern in Garden centres
Resources required: Staff time

Objective 1.6 Monitoring, evaluation and adaptation

To implement national-level monitoring in order to track the progress towards the 50% target and to evaluate efficacy of actions regularly to adapt them to emerging threats.

Actions

1.6.1 Monitor progress towards PNPN3 target

Purpose: The aim of this action is to find out whether we are on track to achieve the global goal.
How: The national biodiversity monitoring will have to be complemented – if necessary - by specific monitoring of the targeted endangered species and IAS. Monitoring population trends of native and endangered species, along with assessing the health and functionality of ecosystems previously degraded, will help determine the effectiveness and speed of recovery following IAS control measures and habitat restoration efforts. For this, clear, periodic evaluation milestones should be set.
Linked actions: 1.1.1, 1.1.2, 1.2.1, 1.6.2
Who: PNPN3 working group Restoration, GC-EEE, LIST, COL
By when: 2026-2030
Indicator: Annual review of progress
Resources required: Staff time

1.6.2 Reevaluate and adapt the actions if necessary

Purpose: Ensuring the successful achievement of the overall target.
How: The monitoring results must be used to adjust the aforementioned actions, if necessary, to ensure the overall target is achieved.
Linked actions: 1.1.1, 1.1.2, 1.2.1., 1.6.1.
Who: GC-EEE
By when: 2027 - 2030
Indicator: Assessment of the implemented actions
Resources required: Staff time

Goal 2 IAS Management in key habitats

Efficient adaptive IAS management and monitoring systems established in hotspots of threatened species, key habitats restored, and pathways and responsibilities for disposal of IAS waste established.

Objective 2.1 Protecting hotspots of threatened species

To identify spatial hotspots of species threatened by IAS by 2025, implement targeted control measures in priority areas by 2026, and monitor success.

Actions

2.1.1 Identify and prioritise hotspots for IAS control

Purpose: Focus on areas with the highest number of species threatened by IAS and highest number of IAS species, e.g. *Haff Réimech - Baggerweieren*, *Cornelysmillen*, *Dumontshaff*, *Schlammwiss*, former open-cast mining areas
Note: Use the layer of protected and potential ZPIN. Necessary to link threatened species to IAS that might have an impact. Being partly implemented: cf. project ANF/LSC.
How: GIS and expert analysis, distribute information
Linked actions: 1.2.1, 2.1.2, 2.1.3, 2.1.4
Who: MNHN, ANF
By when: 2025
Indicator: Priority list and maps available
Resources required: Staff time

2.1.2 Survey populations of threatened species to update information on their status and potential threats by IAS

How: Gap analysis: Which species are already covered by existing projects, which species needs surveys? Analysis and field work as already implemented in the MNHN atlas project for other species. Analysis of threats.
Linked actions: 1.2.1, 1.4.1, 1.4.2, 1.4.3
Who: MNHN, LIST, COL
By when: 2027
Indicator: Survey completed
Resources required: Staff time, travel costs

2.1.3 Develop a spatially explicit IAS management plan for each priority area

Purpose: Creating the basis for an efficient control of IAS in these particularly important areas including potential source areas of IAS
How: In order of priority list. These specific management plans need to be integrated in management plans for ZPIN, Natura 2000 areas, and water framework directive.
Note: AGE Management Plan is currently under development (2027-2033)
Linked actions: 1.2.1, 1.2.2, 2.1.1, 2.1.2
Who: MECB, ANF, AGE, etc.
By when: 2025-2030

Indicator: Existing management plan for every biodiversity hotspot area
Resources required: Staff time, GIS, travel costs

2.1.4 Implement IAS control and prevention measures in each priority area

Purpose: Ensure that the control of IAS is focussed on the most important areas
How: Coordination by regional / local IAS coordinators, focusing on the highest priority areas first
Linked actions: 1.1.2, 1.2.2, 1.4.2, 2.1.1, 2.1.3
Who: ANF, AGE, etc.
By when: Starting 2026
Indicator:
Resources required: Staff time

2.1.5 Monitor status of threatened species in response to IAS control measures in each priority area

Purpose: Determine that the control of IAS is successful or adjust it if necessary
How: Coordination by regional / local IAS coordinators, monitoring of threatened species and habitats as well as IAS
Note: Integration in existing monitoring schemes
Linked actions: 1.2.1, 1.2.2, 2.1.2, 2.1.3, 2.1.4
Who: MECB, ANF, AGE, LIST, COL
By when: 2027
Indicator: Monitoring report
Resources required: Staff time

2.1.6 Perform ecosystem restoration measures after IAS control

Purpose: Following the implementation of management measures against invasive plant species over large areas, it may be necessary to restore the ecosystems concerned, particularly in order to limit the risk of invasive species re-establishing themselves. Decision making by people on the ground.
How: One restoration measure could be the sowing or planting of suitable native plants to avoid the presence of bare soil, which is often one of the conditions that favour the establishment of non-native species (PFEIFFENSCHNEIDER & HOPPE 2021b).
Linked actions: 1.1.2, 1.2.2, 1.4.1, 1.4.2, 2.1.3
Who: MECB, ANF, AGE, Stations biologiques
By when: 2026-2030
Indicator: Restoration measures completed
Resources required: Staff time, seeds, machinery

Objective 2.2 Restoring the habitats of threatened species and the habitats of Community interest

To protect and restore ecosystems in order to provide potential new habitats for threatened species and increase their population size by 2030.

Actions

2.2.1 Optimising the overall quality of watercourses - habitat type 3260

Purpose: For the habitat type 3260, the improvement of water quality and continuity, as well as the creation of extensive buffer strips, are important measures to improve its overall quality and thus the situation of threatened aquatic species.
Note: Action Plan by AGE is currently being implemented within the water framework directive
Linked actions: 1.4.1, 1.4.2., 1.4.3, 2.2.2, 2.2.4
Who: AGE, ANF
By when: 2027
Indicator: Monitoring report in water framework directive
Resources required: Staff time

2.2.2 Optimising the overall quality of riparian strips and restoring the habitat - habitat type 6430

Note: This habitat type is frequently occupied by invasive alien plant species. Conflict with agriculture prevents progress in protecting and developing this habitat type. Agri-environmental schemes do not align with this habitat type but some biodiversity measures[1] could be used for improving the quality of this habitat type. Riparian strips are required under nitrate directive. Implementation realistic mainly in Natura 2000 sites. Communication with agriculture necessary.
How: Creation of riparian vegetation along watercourses and implementing management measures against IAS.
Linked actions: 1.4.1, 1.4.2, 1.4.3, 2.2.1
Who: AGE, ANF, Stations biologiques
By when: 2027
Indicator: Results of the national biotope cadastre and its monitoring.
Resources required: Staff time, machines, travel costs

2.2.3 Optimising the overall quality of ponds and creating additional ponds - habitat type 3150

Purpose: Increase and improve this habitat type, which is also a habitat for many endangered species.
Note: Many new ponds have been already created by Stations biologiques, natur&ëmwelt ,…
Linked actions: 1.4.1, 1.4.2, 1.4.3, 2.2.1, 2.2.2
Who: ANF, Stations biologiques, natur&ëmwelt, AGE
By when: 2027
Indicator: Results of the national biotope cadastre and its monitoring as well as data from the GeNa database.
Resources required: Staff time, machines, travel costs

[1] *Règlement grand-ducal du 24 juillet 2024 relatif aux aides en faveur de la sauvegarde de la biodiversité en milieu rural.*

2.2.4 Optimising the overall quality of alluvial forests and restoring the habitat - habitat type 91E0

Purpose: Restoring this rare forest habitat type along watercourses.
How: Implementation of the existing action plan.
Linked actions: 1.4.1, 2.2.1
Who: ANF, AGE
By when: 2027
Indicator: Results of the national forest biotope cadastre and its monitoring
Resources required: Staff time, machines, travel costs

Objective 2.3 Determining disposal channels

To determine disposal routes for green waste and dead animals resulting from IAS control measures by 2025.

Actions

2.3.1 Identify disposal routes for green waste in consensus with all stakeholders

Purpose: Development of a national plan on where green waste can be delivered and neutralised and under what conditions.
Note: It is essential to resolve the issue of how to handle the green waste generated by management measures for IAS. Discussions with biogas plant operators and industrial composting facilities have so far encountered significant obstacles on a technical/scientific level. The problem must be solved at a political level by the responsible ministry. Relevant information in relation to available disposal routes has to be included into management plans.
These measures are also part of the national strategy on invasive alien species (objective 6) (QUACK et al 2024).
Linked actions: 1.1.1, 1.1.2, 2.1.3, 2.1.4
Who: MECB, ANF, AEV
By when: 2025
Indicator: Procedure and map with disposal points
Resources required: Staff time

2.3.2 Identify disposal routes for dead animals in consensus with all stakeholders

Purpose: Development of a national plan on how and where larger quantities of relevant animal species can be utilised or destroyed
Note: Some animal material might be interesting for research (MNHN).
How:
Linked actions: 1.1.1, 1.1.2, 2.1.3, 2.1.4
Who: MECB, ANF, AEV, ALVA
By when: 2025
Indicator: Procedure and map with disposal points
Resources required: Staff time, consultations

2.3.3 Elaborate prevention plans and hygiene protocols for avoiding the risk of spreading invasive alien species and pathogens

Purpose: Avoid spreading IAS by management measures
Note: Risk of spread by animals and general public. Hygiene protocols are already in place for Bsal/Bd, but may not be followed by all necessary stakeholders; special protocols might be required for other IAS.
Linked actions: 1.1.1, 1.1.2, 2.1.3, 2.3.1, 2.3.2
Who: MECB, ANF, ALVA, Stations biologiques
By when: 2026
Indicator: Hygiene protocols in place
Resources required: Staff time, consumables

Goal 3 Threatened Species Management

Specific IAS control systems established for species threatened by IAS, progress monitored and key habitats for threatened species restored.

Objective 3.1 Protecting amphibians against Bd and Bsal

To establish biosecurity protocols, monitoring standards and restore potential future habitats for amphibians threatened by chytrid fungi by 2026.

Note: Amphibians are threatened by *Batrachochytrium dendrobatidis* (Bd) and *Batrachochytrium salamandrivorans* (Bsal), two devastating fungal pathogens responsible for global amphibian declines. This requires a combination of actions aimed at prevention, detection, control, and conservation.

Actions

3.1.1 Biosecurity protocols

Purpose: To avoid the unintended spread of spores of chytrid fungi
How: Implement strict biosecurity measures for field researchers, conservation workers, and anyone entering amphibian habitats. This includes decontaminating equipment, footwear, and clothing between sites using disinfectants.
Note: ANF has created a task force to inform stakeholders, not all may be implementing the protocols, fishermen and AGE need to be informed.
Linked actions: 2.1.3, 2.1.4
Who: Field biologists, conservation workers, FLPS, AGE, Stations biologiques
By when: 2025
Indicator: Existing protocols and communication
Resources required: Staff time, consumables

3.1.2 Environmental monitoring of *Bd*/*Bsal*

Purpose: Controlling the spread of *Bd* and *Bsal* and containment of outbreaks
Note: This measure has to be coordinated with the National Action Plan on Emerging Infectious Diseases affecting amphibians (STASSEN & LESTANG 2023).
How: Set up surveillance programs to monitor amphibian populations for the presence of *Bd* and *Bsal*. This can involve collecting skin swabs from amphibians or sampling water sources in habitats for environmental DNA (eDNA), which can detect the presence of fungal spores. Identifying infections early is critical to controlling their spread. Citizen science programs: Involve local communities and citizen scientists in monitoring amphibian populations and reporting any unusual amphibian deaths or signs of disease including training on biosecurity protocols. If *Bd* or *Bsal* is detected in a particular area, establish quarantine zones to prevent the movement of amphibians in and out of the infected region. This can help contain the spread of the pathogens.
Note: A Bd/Bsal monitoring program exists already
Linked actions: 2.1.3
Who: ANF, MNHN, Stations biologiques, LIST
By when: 2025
Indicator: Bd/Bsal monitoring report

Resources required: Staff time, travel costs, lab consumables

3.1.3 Reintroduction and translocation of amphibian species

Purpose: Strengthening the population of endangered amphibian species
Note: Reintroduction is already carried out for Yellow-bellied toad (*Bombina variegata*), European tree frog (*Hyla arborea*), Great Crested Newt (*Triturus cristatus*) (SICONA), and planned for Natterjack toad (*Epidalea calamita*) (SICONA)
How: Ex situ breeding to reduce losses in the first stages of life. The animals are then released into suitable habitats.
Linked actions: 3.1.1
Who: Stations biologiques, LIST
By when: 2025-2030
Indicator: Population of endangered amphibian species
Resources required: Staff time and funding

3.1.4 Ex situ conservation and breeding program for *Salamandra salamandra*

Purpose: Conservation and strengthening of the population of *Salamandra salamandra*
How: Ex situ breeding to reduce losses in the first stages of life. Ex situ conservation so that the population can be reintroduced after the *Bsal*
Linked actions: 3.1.2, 3.1.3
Who: ANF, MNHN, Stations biologiques
By when: 2028
Indicator: Population of *Salamandra salamandra*
Resources required: Staff time and funding

Objective 3.2 Habitat restoration and specific management for endangered native mussels

To develop habitat restoration plans and reintroduction plans for the regionally extinct Freshwater Pearl Mussel (*Margaritifera margaritifera*), to develop specific management for existing populations of Thick Shelled River Mussel (*Unio crassus*) and to protect native species from IAS.

Actions

3.2.1 Develop and implement a spatially explicit habitat restoration plan

Purpose: Improving habitat quality and implementing control measures against IAS.
Note: *Margaritifera margartifera* is regionally extinct in Luxembourg; priority actions have to focus on improving habitat quality for future reintroductions which will also be beneficial for *Unio crassus*. AGE wants to achieve a good condition of the Our by 2027. A major problem are eutrophication and sediments from agriculture. A special plan is required to solve this problem. Cross-border collaboration is required. Long-term reintroduction should be envisaged.
Linked actions: 3.2.2
Who: AGE
By when: 2030
Indicator: Habitat quality that fulfils the minimum requirements of the species.
Resources required: Staff time, biodiversity funding for farmers

3.2.2 Conservation management for *Unio crassus*

Purpose: Strengthening the population by habitat improvement and targeted control of IAS
Note: Although *Unio crassus* will benefit from habitat improvements, measures to control IAS must be implemented simultaneously. Cf. existing action plans.
How: Implementation of the respective action plans that exist for *Unio crassus, Ondatra zibethicus, Procyon lotor* and *Pacifastacus leniusculus.* Implementation of management measures against *Dreissena* sp. for example manual removal. While labor-intensive, this can be effective for small or localised populations. Installing physical barriers like mesh screens on water intakes and other vulnerable infrastructure can prevent mussels from colonising these structures. Since effective control measures are difficult once the species are well established, prevention is very important. These measures have to be implemented at a local level.
Linked actions: 3.2.1
Who: AGE, natur & ëmwelt
By when: 2028
Indicator: Management in place
Resources required: Staff time, machines, equipment

Objective 3.3 Develop specific measures for threatened crayfish

To restore habitats and develop specific measures for threatened crayfish by 2028.

Actions

3.3.1 Survey for potential remaining populations of native crayfish species

Note: No recent records of native crayfish species remain in Luxembourg; they may potentially occur in streams running into the "Obersauerstausee".
How: Potential sites, where crayfish may occur should be surveyed.
Linked actions: 2.1.2, 3.2.1, 3.4.2
Who: MECB, AGE, MNHN, LIST
By when: 2026
Indicator: Report on distribution of native crayfish
Resources required: Staff time, travel costs

3.3.2 Conservation management for populations of native crayfish species

Purpose: Strengthening the population by habitat improvement and targeted control of IAS
Note: Free flowing river strategy needs careful planning of dam removal.
How: To protect endangered crayfish, streams where they were last observed should be cleared of invasive alien crayfish species. This includes streams such as *Aalbaach* (Dreiborn), *Rouderbaach* (Grevenmacher), *Bärzbech*, *Bollertsbaach, Burbaach*, and *Huschterbaach* in the *Dickt* forest area, north of Wahlhausen. Strengthen the existing population in the ponds within the *Dickt* area. Analyse the possibility of releasing native crayfish species in the *Béiwenerbaach*.
Linked actions: 2.1.2, 3.2.1, 3.3.1, 3.4.2
Who: AGE, MNHN, LIST
By when: 2028
Indicator: Existing populations of native crayfish in the wild
Resources required: Staff time and funding

3.3.3. Strict containment of crayfish plague

Purpose: Protecting populations of native crayfish species
How: To protect threatened crayfish and to improve the potential for recolonisation, streams where they were last observed should be cleared of invasive alien crayfish species. This action should be tried out first on streams with existing dams, that prevent or contain the spread of invasive species. Working in sections between the dams allows an assessment of the prospects for this measure. If successful, an alternative in streams without dams, would be the installation of crayfish barriers.
Linked actions: 2.1.2, 3.3.2, 3.4.1, 5.1.1
Who: AGE, LIST, ANF
By when: 2030
Indicator: Selected streams are free of invasive alien crayfish and crayfish plague
Resources required: Staff time and funding

Objective 3.4 Protect threatened aquatic plant species

To develop specific actions to reduce the effects of IAS on threatened aquatic plant species by 2026.

Actions

3.4.1 Prevention during activities related to ponds

Purpose: Preventing the spread of invasive aquatic plant species
How: Emphasise practices like cleaning boats, fishing gear and water sports equipment before moving them between water bodies.
Linked actions: 1.4.1, 2.2.3, 2.3.3, 3.1.1
Who: AGE, ANF, Stations biologiques, fishermen, municipalities, general public
By when: 2026
Indicator: Existing procedure
Resources required: Staff time, equipment

3.4.2 Prevention during the implementation of control measures

Purpose: Preventing the spread of invasive aquatic plant species
How: Install physical barriers such as screens or nets to prevent the spread of invasive species into protected areas where endangered plants thrive. Clean all material. Appropriate disposal of the plant material. Supervise any control measures thoroughly.
Linked actions: 1.1.2, 1.4.1, 2.2.3, 2.3.3, 3.1.1
Who: AGE, ANF, Stations biologiques, municipalities
By when: 2026
Indicator: Prevention protocols in place
Resources required: Staff time, equipment

3.4.3 Implement control measures

Purpose: Free selected ponds and lakes from IAS or keep them IAS free
How: Remove IAS manually or mechanically from water bodies, especially in early infestation stages.
Linked actions: 1.1.2, 1.3.2, 1.3.3, 2.1.3, 2.3.1
Who: MECB, AGE, ANF, Stations biologiques, fishermen, general public
By when: 2026
Indicator: Procedure and map with disposal points
Resources required: Staff time, equipment

Goal 4 Research

Impact of IAS on threatened species and habitats as well as efficiency of control measures better understood, and monitoring methods improved.

Objective 4.1 Improving knowledge on impact of IAS on threatened species and habitats

To improve knowledge of the impact of IAS on threatened species and habitats by 2030.

Actions

4.1.1 Quantifying the impact of *Lemna minuta* on threatened species

Purpose: Get a better knowledge of the impact of *Lemna minuta* on threatened aquatic animal and plant species.
How: Literature research, contact with foreign experts and, if necessary, own scientific studies
Linked actions: 2.1.3, 2.1.4, 2.2.3, 2.3.3
Who: MNHN, LIST, AGE, ANF, Stations biologiques
By when: 2030
Indicator: Existing evaluation
Resources required: Staff time, travel costs, equipment

4.1.2 Monitoring with eDNA

Purpose: Optimising monitoring with eDNA. Developing fast and efficient methods to detect IAS using eDNA.
Note: Protocols exist and must be implemented
Linked actions: 1.6.1, 2.1.2, 3.1.2
Who: MNHN, LIST
By when: 2027
Indicator: Monitoring scheme in place
Resources required: Staff time, lab consumables, travel costs

4.1.3 Research on the existence and the impact of different strains of Bd

Purpose: Avoid mixing of genotypes (if there are)
How: Literature research, contact with foreign experts and, if necessary, own scientific studies
Linked actions: 3.1.2
Who: MNHN, LIST, AGE, ANF
By when: 2030
Indicator: Existing conclusions
Resources required: Staff time, lab consumables, travel costs

4.1.4 Impact of invasive alien crayfish species on dragonflies

Purpose: Evaluate the impact if invasive alien crayfish species on (threatened) native dragonflies
How: Literature research, contact with foreign experts and own scientific studies
Linked actions: 2.1.2

Who: MNHN
By when: 2029
Indicator: Existing assessment
Resources required: Staff time, consumables

4.1.5 Potential of remote sensing methods

Purpose: Evaluate the potential of remote sensing for detection of IAS and monitoring of control measures
How: Literature research, contact with foreign experts and own scientific studies
Linked actions: 1.6.1, 2.1.3, 2.1.5
Who: LIST, MNHN, ANF, OAI
By when: 2028
Indicator: Existing evaluation
Resources required: Staff time, drones and other equipment

4.1.6 Existence of resistant *Astacus astacus* populations

Purpose: Evaluation if the *Astacus astacus* population in the state-owned fishpond in Lintgen is resistant against the crayfish plague which would increase the chances of a successful reintroduction of the species.
How: Analyses of the population in the pond in Lintgen. Reintroduction in the *Béiwenerbaach*.
Linked actions: 3.4.1, 3.4.2
Who: MNHN, AGE
By when: 2030
Indicator: Resistant population
Resources required: Staff time, equipment, consumables

4.1.7 Impact of *Vespa velutina* on (threatened) native insects

Purpose: While the impact of *V. velutina* on honeybees is well known, the potential impact on wild bees and other insects should be evaluated.
How: Literature research, contact with foreign experts and own scientific studies
Linked actions: /
Who: MNHN, LIST, ANF
By when: 2029
Indicator: Existing evaluation
Resources required: Staff time, equipment

4.1.8 Impact of invasive alien geese on reedbeds in the *Haff Réimech* reserve and endangered species that are dependent on this habitat

Purpose: Assess how big the impact of Canada an Egyptian geese on reedbeds and endangered species really is.
How: Literature research, contact with foreign experts and own scientific studies
Linked actions: 2.1.2
Who: MNHN, natur & ëmwelt, LIST, ANF
By when: 2029
Indicator: Existing evaluation
Resources required: Staff time

4.1.9 Invasive alien mammal species monitoring with camera traps in forests

Purpose: Optimising monitoring with camera traps. Developing fast and efficient methods to detect IAS using camera traps in forests.
Note: Protocols exist and must be implemented
Linked actions: 1.2.3
Who: LIST
By when: 2027
Indicator: Monitoring scheme in place
Resources required: Staff time, travel costs, equipment (e.g. for real-time data transmission)

Objective 4.2 Improving knowledge on efficient control of invasive pathogenic fungi

To improve knowledge on efficient measures to control the impact of pathogenic fungi on threatened plants and animals by 2030.

4.2.1 Explore methods to control the Dutch elm disease pathogens *Ophiostoma ulmi* and *Ophiostoma novo-ulmi*

Note: Several other pathogens have been tested as factors debilitating the fungi (e.g. the virus "d-factor", the fungus *Verticilium dahliae*). Some plant phenolics (carvacrol, salicylic acid) have been shown to provide in vivo protection against *O. novo-ulmi*. Screening elms for resistance to *O. novo-ulmi* is also a possible option.
How: Literature research, contact with foreign experts and, if necessary, own scientific studies
Linked actions: /
Who: ANF, ASTA
By when: 2030
Indicator: Evaluation of different control measures available
Resources required: Staff time, lab consumables, travel costs

4.2.2 Explore methods to control the Ash dieback pathogen *Hymenoscyphus fraxineus*

Note: Several other pathogens have been tested as factors debilitating the fungi (e.g. the *Hymenoscyphus fraxineus* mitovirus 2 (HfMV2)).
How: Literature research, contact with foreign experts and, if necessary, own scientific studies
Linked actions: 2.2.4
Who: ANF, ASTA
By when: 2030
Indicator: Evaluation of different control measures available
Resources required: Staff time, lab consumables, travel costs

4.2.3 Evaluate the impact of *Phytophthora ramorum and P. kernoviae fungi on beeches, oaks ("sudden oak death") and other tree species*

Purpose: Improve knowledge about the impact of these fungi and *Rhododendron ponticum* as reservoir host.
How: Literature research, contact with foreign experts and, if necessary, own scientific studies
Linked actions: /

Who: ANF
By when: 2030
Indicator: Existing evaluation
Resources required: Staff time, lab consumables, travel costs

Goal 5 Public Awareness

Awareness of the species threatened by IAS and the main problematic IAS increased, as well as local stakeholders actively engaged in IAS control and prevention.

Objective 5.1 Increasing public awareness

To increase public awareness about the threats posed by IAS and the native species threatened by them by 2027 as well as information about the responsible key actors.

Note: As this objective is dealt with in detail in the national strategy on invasive species (measures 7.1 and 7.2), we focus on the parts that are particularly relevant to this action plan.

5.1.1 Targeted awareness raising in hotspots of threatened species where IAS pose a relevant threat

Note: Focus on actors who are likely to spread or deal with IAS, e.g. tourists, municipalities, …
How: Based upon hotspot analysis - as part of the management plan for the respective area.
Linked actions: 2.1.3
Who: MECB, ANF, AGE, Stations biologiques
By when: 2026
Indicator: Awareness campaign launched
Resources required: Staff time, travel costs, consumables

5.1.2 Raising awareness on species threatened by IAS

How: Present the endangered species, their habitats and the reasons for their endangered status. Explain the causes that make IAS one of the reasons for endangerment.
Linked actions: 2.1.2
Who: MECB, ANF, AGE, Stations biologiques, MNHN
By when: 2026
Indicator: Awareness campaign launched
Resources required: Staff time, travel costs, consumables

4. Literature

ANONYMOUS (2014): Regulation (EU) No 1143/2014 of the European parliament and of the council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species, Official Journal of the European Union, L 317/35, 04.11.2014.

COLLING, G., T. HELMINGER, Y. KRIPPEL, S. SCHNEIDER, L. DACO (in prep): Red List of the Vascular Plants of Luxembourg.

EEA - EUROPEAN ENVIRONMENT AGENCY (2012): The impacts of invasive alien species in Europe, ISBN 978-92-9213-345-0, 114 pp.

IUCN/SSC. 2008. Strategic planning for species conservation: A handbook. Version 1.0., Gland, Switzerland: IUCN Species survival commission. 104 pp.

MNHNL (2000): Recorder-Lux, database on the natural heritage of the Grand Duchy of Luxembourg. Musée national d'histoire naturelle, Luxembourg. URL: https://map.mnhn.lu.

MECDD (2023): Plan National concernant la Protection de la Nature – 3e Plan à l'horizon 2030, 62 pp.

OLY, M. (2022): Kartierung invasiver gebietsfremder Wasserpflanzen im Großherzogtum Luxemburg, Untersuchungen zur Verbreitung von invasiven gebietsfremden Wasserpflanzen in einer beispielhaften Auswahl an Stillgewässern, unveröff. Studie im Auftrag des MNHN, 104 pp.

OPENAI. (2024). CHATGPT. Https://chat.openai.com/chat

PFEIFFENSCHNEIDER, M. & F. HOPPE, 2021a. Plan d'action concernant les principales voies d'introduction et de propagation d'espèces exotiques envahissantes au Grand-Duché de Luxembourg. Évasion de plantes ornementales et d'espèces aquatiques. Etude non publiée pour le compte du MECDD, 17 pp.

PFEIFFENSCHNEIDER, M. & F. HOPPE, 2021b. Plan d'action concernant les principales voies d'introduction et de propagation d'espèces exotiques envahissantes au Grand-Duché de Luxembourg. Propagation naturelle de populations existantes. Etude non publiée pour le compte du MECDD, 22 pp.

PFEIFFENSCHNEIDER, M. & F. HOPPE, 2021c. Plan d'action concernant les principales voies d'introduction et de propagation d'espèces exotiques envahissantes au Grand-Duché de Luxembourg. Propagation par l'utilisation de terre, de pierres, de concassé ou de compost contaminés. Etude non publiée pour le compte du MECDD, 14 pp.

PFEIFFENSCHNEIDER, M. & F. HOPPE, 2021d. Plan d'action concernant les principales voies d'introduction et de propagation d'espèces exotiques envahissantes au Grand-Duché de Luxembourg. Élimination de déchets verts. Etude non publiée pour le compte du MECDD, 16 pp.

QUACK, M. J. KLEIN & J. GERHARD (2024): Nationale Strategie zu invasiven gebietsfremden Arten in Luxemburg. Hrsg.: Administration de la nature et des forêts, Diekirch. 58 S.

RABITSCH, W., T. HEGER, J. JESCHKE, W-C. SAUL, S. NEHRING (2018): Analyse und Priorisierung der Pfade nicht vorsätzlicher Einbringung und Ausbreitung invasiver gebietsfremder Arten in Deutschland gemäß Verordnung (EU) Nr. 1143/2014, BfN-Skripten 490

STASSEN, R., L. LESTANG (2023): Plan d'action national sur les maladies infectieuses émergentes touchant les amphibiens au Grand-Duché de Luxembourg (2023-2028), Study commissioned by the Administration de la nature et des forêts, Final version of 09.02.2023, pp. 27

Annexe

Timeline for the implementation of the action plan

Goal	Objective	Action	Name of action	2025	2026	2027	2028	2029	2030
1	1.1	1.1.1	Creation of a steering group	x	x	x	x	x	x
1	1.1	1.1.2	Appointment of regional and local IAS coordinators	x	x	x	x	x	x
1	1.1	1.1.3	Coordination in the Greater Region		x	x	x	x	x
1	1.2	1.2.1	Ensure efficient data management		x	x	x	x	x
1	1.2	1.2.2	Geoportal for tracking IAS control measures		x	x	x	x	x
1	1.2	1.2.3	Develop a tool for tracking IAS at the Greater Region level				x	x	x
1	1.3	1.3.1	Early warning system	x	x	x	x	x	x
1	1.3	1.3.2	Information transfer	x	x	x	x	x	x
1	1.3	1.3.3	Setting up and training control teams		x	x	x	x	x
1	1.3	1.3.4	Change authorisation procedurs	x	x	x	x	x	x
1	1.4	1.4.1	Integration in Habitat Action Plans			x	x	x	x
1	1.4	1.4.2	Consideration of IAS control in Natura 2000 / ZPIN management						
1	1.4	1.4.3	Consideration of IAS control in Water Framework Directive	x	x	x	x	x	x
1	1.4	1.4.4	IAS management in context of Nature Restoration Law		x	x	x	x	x
1	1.5	1.5.1	Implementation of action plans for prevention	x	x	x	x	x	x
1	1.5	1.5.2	Optimizing law enforcement regarding dispersal of IAS	x	x	x	x	x	x
1	1.6	1.6.1	Monitoring progress towards 50% target		x	x	x	x	x
1	1.6	1.6.2	Re-evaluation and adaptation			x	x	x	x
2	2.1	2.1.1	Identify and prioritise control areas and IAS species	x	x	x			
2	2.1	2.1.2	Survey threatened species for potential threats by IAS	x	x	x	x	x	x
2	2.1	2.1.3	Spatially explicit IAS management plans	x	x	x	x	x	x
2	2.1	2.1.4	IAS control implementation		x	x	x	x	x
2	2.1	2.1.5	Monitoring species response to IAS control	x	x	x	x	x	x
2	2.1	2.1.6	Ecosystem restoration measures after IAS control		x	x	x	x	x
2	2.2	2.2.1	Restoration of watercourses	x	x	x	x	x	x
2	2.2	2.2.2	Restoration of riparian strips	x	x	x	x	x	x
2	2.2	2.2.3	Restoration of ponds	x	x	x	x	x	x
2	2.2	2.2.4	Restoration of alluvial forests	x	x	x	x	x	x
2	2.3	2.3.1	Identify disposal routes for green waste	x	x	x	x	x	x
2	2.3	2.3.2	Identify disposal routes for dead animals	x	x	x	x	x	x
2	2.3	2.3.3	Hygiene protocols for invasive alien pathogens and species		x	x	x	x	x
3	3.1	3.1.1	Biosecurity protocols for Bsal/Bd	x	x	x	x	x	x
3	3.1	3.1.2	Bd/Bsal monitoring	x	x	x	x	x	x
3	3.1	3.1.3	Amphibien reintroductions	x	x	x	x	x	x
3	3.1	3.1.4	Ex situ conservation for *Salamandra salamandra*			x	x	x	x
3	3.2	3.2.1	Restoration plan for *Margaritifera margaritifera*				x	x	x
3	3.2	3.2.2	Population management for *Unio crassus*		x	x	x	x	x
3	3.3	3.3.1	Survey for potential native crayfish populations	x	x	x	x		
3	3.3	3.3.2	Population management for native crayfish		x	x	x	x	x
3	3.3	3.3.3	Strict containment of crayfish plague		x	x	x	x	x
3	3.4	3.4.1	Prevention of IAS spread among freshwater habitats		x	x	x	x	x
3	3.4	3.4.2	Prevention of IAS spread during control measures		x	x	x	x	x
3	3.4	3.4.3	IAS control in ponds and lakes		x	x	x	x	x
4	4.1	4.1.1	Quantifying the impact of *Lemna minuta* on threatened species		x	x	x	x	x
4	4.1	4.1.2	Monitoring with eDNA		x	x	x	x	x
4	4.1	4.1.3	Research on different strains of Bd		x	x	x	x	x
4	4.1	4.1.4	Research on impact of invasive alien crayfish on dragonflies		x	x	x	x	
4	4.1	4.1.5	Research on potential of remote sensing methods		x	x	x	x	x
4	4.1	4.1.6	Research on resistant *Astacus astacus* populations		x	x	x	x	x
4	4.1	4.1.7	Resarch on impact of *Vespa velutina* on threatened insects		x	x	x	x	
4	4.1	4.1.8	Research on impact of invasive geese on reedbeds in Haff Réimech		x	x	x	x	
4	4.1	4.1.9	Research on improving monitoring of IAS mammals with camera traps in forests		x	x			
4	4.2	4.2.1	Explore methods to control Dutch elm disease		x	x	x	x	x
4	4.2	4.2.2	Explore methods to control Ash dieback		x	x	x	x	x
4	4.2	4.2.3	Evaluate impact of Phytophthora fungi on beeches		x	x	x	x	x
5	5.1	5.1.1	Targeted awareness raising with stakeholders	x	x	x	x	x	x
5	5.1	5.1.2	Awareness raising on species threatened by IAS	x	x	x	x	x	x