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Ludwigia spp

Species description

The invasive water primrose (*Ludwigia grandiflora*) and floating primrose-willow (*Ludwigia peploides*) are both aquatic and semi-aquatic vascular plants native to South America. The species were introduced to Europe, including Belgium, through horticultural trade as popular ornamental plants for garden ponds. The first record of water primrose's and floating primrose-willow's presence in the environment in Belgium dates from 1984 and 1995 respectively. Disposal of pond waste and escape from cultivation are probably at the origin of their presence in the wild. Today, both *Ludwigia* spp. represent problematic aquatic invasive species in many countries worldwide and are now listed as IAS of Union concern under the (EU) Regulation No 1143/2014. The distribution of both species on the Belgian territory is probably rather exhaustive due to their high detectability.

Fig 1. *Ludwigia peploides*. Photo: KENPEI

Fig 2. *Ludwigia grandiflora*. Photo: Traumrune

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Photo: Heliosphile/Shutterstock.

Ludwigia spp.

Ludwigia spp. thrive in stagnant or slow-moving freshwater habitats such as ponds, ditches and canals. The plants can grow up to 1m above the water surface and are able to colonise wet terrestrial environments such as banks or meadows. As highly competitive invasive species, the plants have diverse environmental, social and economic impacts. They can form dense mats that can completely cover the water surface. This has significant detrimental impacts on the ecosystem and biodiversity including through light exclusion, native plant community displacement and water quality modification. Social and economic consequences involve restriction of recreational activities (angling, boating), and management-related costs.

Fig 3. Water primrose invasion, expanding rapidly, can disturb human activities such as navigation. Photo : COULANGES/Shutterstock

Biological characteristics, reproduction and spread

Water primrose displays different growth forms and develops both under and above the water surface. During the initial growth phase, it produces stems that grow horizontally over the ground and the water surface. The stems, then, start growing vertically (up to 1m tall) during the second phase. The species grows in spring, and flowering mainly takes place between July and September. Floating primrose-willow also produces stems that can grow both vertically and horizontally. The species' leaves become apparent at the water surface in early spring. Flowering takes place from July to October. Emerging stems sink back to the bottom in November. The two species are amphibious and can develop up to 3m deep underwater and take root both in the sediments and banks. When colonizing terrestrial environments, both species can sometimes display an atypical creeping form. At the beginning of the growing season, these species are not easily detectable as they present small leaves.

Reproduction of *Ludwigia* spp. in western Europe is mainly vegetative. When the plant breaks into fragments, whether naturally or due to human activity, those stem fragments, measuring a few cm in lenght, can form a new plant, and therefore, a new population away from the initial invaded area. Fragmentation naturally occurs in autumn and winter, when the plants die off. Sexual reproduction is, however, also known to occur as both species can produce viable seeds. Each species produces fruits holding 40 to 50 seeds and exhibits important potential seed output (several thousand seeds/m²). The seeds of water primrose and floating primrose-willow can remain buoyant for 12 weeks and 2 weeks, respectively.

References

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Sexual reproduction of both species seems, however, to be less important compared to vegetative reproduction. Dispersal occurs via seed and fragment drift, flooding events as well as through fragments being attached to boats and other water equipment. Those high regeneration and dispersal abilities highlight the importance of the implementation of effective management measures.

Fig 4. Water primrose as a floating form during its first growth phase. Photo: Marie Patinet

Fig 5. Atypical creeping terrestrial form. Photo: Arnaud Monty

Fig 6. Mat of flowering water primrose during its second growth phase. Photo: Marie Patinet

Fig 7. Small leaves present at the beginning of the growing season. Photo: Arnaud Monty

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General considerations about management

Numerous and well-documented management options have successfully been used to control and, in some cases, eradicate water primrose and floating primrose-willow. Local eradication of both species is considered challenging, especially for large and dense infestations, but remains possible for early-detected populations. Their ability to colonise both aquatic and terrestrial environments makes management particularly difficult. In addition, the plants' strong roots and thick rhizomes make their removal quite challenging. As *Ludwigia* spp. require full light conditions to express an invasive character, promoting environmental shading through revegetation with native tree or shrub species can help prevent the (re)establishment of these invasive plants. The eradication feasibility of *Ludwigia* spp. populations must always be assessed on a case-by-case basis, considering site specificities, and be thoroughly discussed within the management team.

Due to the species' ability to reproduce by seeds and fragments, precautionary measures must be implemented prior to management to prevent the spread of seeds and fragments into the environment and uninvaded areas. Managed areas are, therefore, isolated by physical barriers.

The harvested plant material must be safely disposed of far away from the water and any wet areas. It is either dried and incinerated, buried (at least 1m deep), or composted. Material that has been in contact with the plant and with the soil that may contain seeds (e.g. machines, nets) should be checked, cleaned and dried before going to another site.

Managed and downstream sites must remain under enhanced surveillance for a 5-year period after the last treatment.

Robert, H. *et al.* (2013) *Risk analysis of the water primrose* Ludwigia peploides *(Kunth) P.H. Raven*. Royal Belgian Institute of Natural Sciences.

Ruaux, B. *et al.* (2009) Sexual reproduction of two alien invasive *Ludwigia* (Onagraceae) on the middle Loire River, France. Aquatic Botany, 90(2), 143–148.

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Manual removal

- v Local eradication can be achieved but remains extremely complicated
- v Manual removal is highly selective and will have minimal disturbance and impact on ecosystems and other organisms
- v This method is also used as a follow-up method in larger-scale eradication programs, when the regrowth is limited
- x The method is only suitable for small and early-detected infestations (< 50m^2)
- x There is a risk to spread fragments to uninvaded areas

Method description

The principle is to remove the whole plant from the ecosystem without breaking the stems or leaving root fragments in the sediments. Plants are pulled out by the roots or dug up with tools by operators either wading in shallow waters, operating from boats or working from the bank. Due to the plant's thick rhizomes and strong roots, digging up could be more effective. Operators must pay great attention not to fragment the plants, but also to remove the entire root system and all individuals also present on the banks. This management strategy is conducted in late spring to prevent seed production. Manual removal is repeated every month during the vegetation period (from May to October) for at least 5 successive years. Water drawdown can be implemented prior to manual removal to facilitate the operation. Containment nets (1m deep) must be installed to prevent fragment spread and must be checked regularly, ideally on a daily basis, to remove fragments that have been caught.

Material

Management: Waders, small boats, spades, rakes.

Transport and stocking: Buckets or waterproof bags, tarpaulin, trucks and wheelbarrows

Precautionary measures: Hand net, containment nets (mesh size < 1cm)

References

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Mechanical removal

- v Rapid good control can be expected
- v Mechanical removal is suitable for well-established populations and large/deep water systems
- x This method can only be implemented in sites where the entire invaded area is accessible to the machines
- x Mechanical removal can create vast numbers of plant fragments with the risk to spread the species to uninvaded areas and other parts of the managed water system
- x Eradication is highly unlikely

Method description

The principle is to mechanically remove the whole plant from the ecosystem. Plants are uprooted and collected either by excavators equipped with a clawed or mowing bucket from the bank or by floating machines equipped with a hydraulic controlled rack. While terrestrial machines are preferred for narrow water systems such as ditches or streams, floating machines are adopted for large water systems. Mechanical removal is implemented in spring to prevent seed production and is immediately followed by manual removal of remaining plants and fragments. If mechanical removal using terrestrial machines is implemented, lowering the water level prior to the operation can facilitate the exercise. This management method generally needs to be repeated for minimum 2 years to achieve eradication. This action is followed by manual aftercare to remove any regrowth during 3 to 5 consecutive years.

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Material

Management: Excavators with a clawed/mowing bucket or floating harvester machines with a hydraulic controlled rack

Transport and stocking: Buckets or waterproof bags, tarpaulin, trucks, dumpers and wheelbarrows

Precautionary measures: Hand net, containment nets (mesh size <1cm)

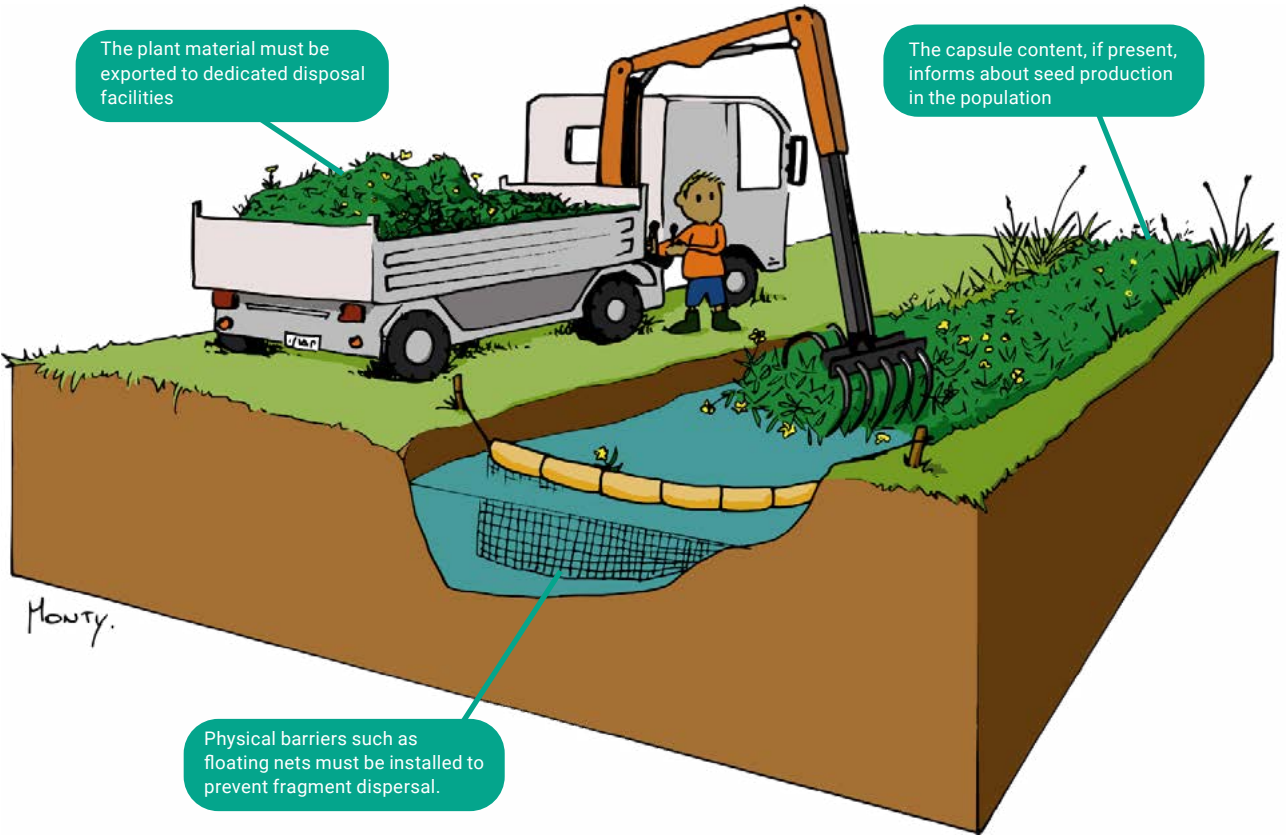

Fig 8. Mechanical removal of *Ludwigia* spp.

Substrate removal: mechanical dredging

- v This is one of the fastest methods to achieve good levels of control
- v This method is suitable for large infestations
- v Mechanical dredging can be implemented when maintenance dredging of the water body is required
- x Local eradication is possible but unlikely
- x This method can only be implemented in sites where the whole area is accessible to the machines
- x Dredging can create vast numbers of plant fragments with the risk to spread the species to uninvaded areas
- x This method can have high negative impacts on aquatic living organisms
- x Disposal sites must be found for the storage of contaminated sediments
- x This method is expensive due to the use of machinery and the need to transport sediments to dedicated disposal sites

Method description

The principle is to remove the bottom sediments contaminated with any parts of the invasive plant such as roots, stems, seeds, etc. Excavators equipped with cleaning bucket thumb are used for excavation. It is strongly recommended to remove a 40cm-layer of sediments to reduce the chance for the species to re-establish. This method is often preceded by a water drawdown or a complete drainage (if possible), during which care should be taken not to spread plant fragments. Mechanical dredging is preferably conducted in late spring or early summer, when the plant is visible but before the start of its accelerating growth phase (August-September). Operators must pay great attention not to fragment the plants (as much as possible). Manual removal is implemented as a follow-up measure for a minimum of 2 to 3 years to remove any regrowth or seedlings. Finding an adequate disposal site for the storage of contaminated sediments must be done before the start of this management action.

References

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Material

Management: Excavators with cleaning bucket, digger

Transport and stocking: Buckets or waterproof bags, tarpaulin, trucks, dumpers and wheelbarrows

Precautionary measures: Hand net, containment nets (mesh size <1cm)

Fig 9. Mechanical dredging of water primrose after a complete drainage of the water body. Photo: Arnaud Monty

Light deprivation: bank cover

v Local eradication can be achieved

v Drastic biomass reduction can occur in a short amount of time

x This method is suitable for small populations on terrestrial environments

x The method is not selective and will impact other living organisms

Method description

The principle is to install bank covers that both compress vegetation and exclude sunlight, causing the death of the plants. Sheets are manually placed by operators on the entire population that has colonised the bank and terrestrial environments. It is crucial to ensure that no light reaches the plants through gaps or at the edges and intersections of the sheeting. Operators must ensure the adequate placement of the bank covers and that strips overlap correctly. The use of large continuous pieces of sheeting is therefore recommended whenever possible. The material is then anchored to the bank. The sheeting is placed in spring or summer and remains in place for a few weeks or months. Manual removal is then implemented as a follow-up measure to remove any regrowth. This method can also be implemented for populations where hand removal is complicated.

Material

Management: The adequate quantity of light-blocking sheeting such as black plastics, PVC or nylon tarp. Weights, rocks, concrete blocks or sandbags.

References

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The impact of management actions on ecosystem services

While the adverse effects of IAS are well-known and provide strong incentives for implementing management actions, the impacts of these management actions on ecosystems and the services they provide are less considered. The matrices are the result of expert assessments of the evolution of relevant ecosystem services (ES) from a highly invaded situation towards a managed situation. ES evolution is considered over 2 given periods of time: 1 year and 5 years after the initiation of management.

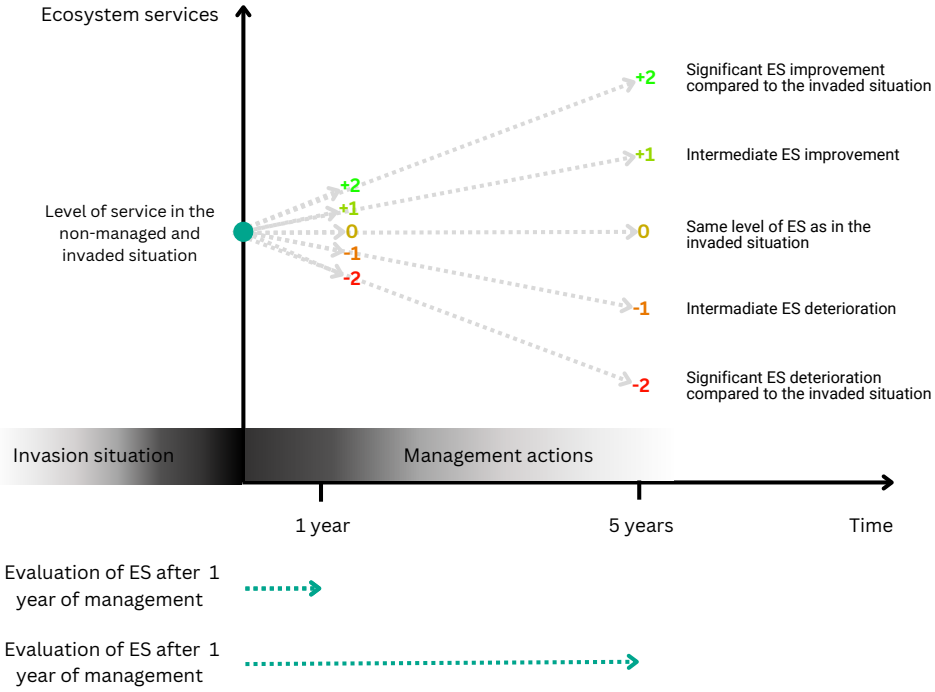

Fig 10. Representation of the survey process

Each matrix displays the average impact scores of management methods on ecosystem services. These scores have been associated to colours to facilitate the visualization of the impacts of every method on every relevant ecosystem service. Green indicates a significant improvement in the ecosystem services (ES) due to management, orange represents no or minimal effect, and red signifies a negative impact of the method on the ES.

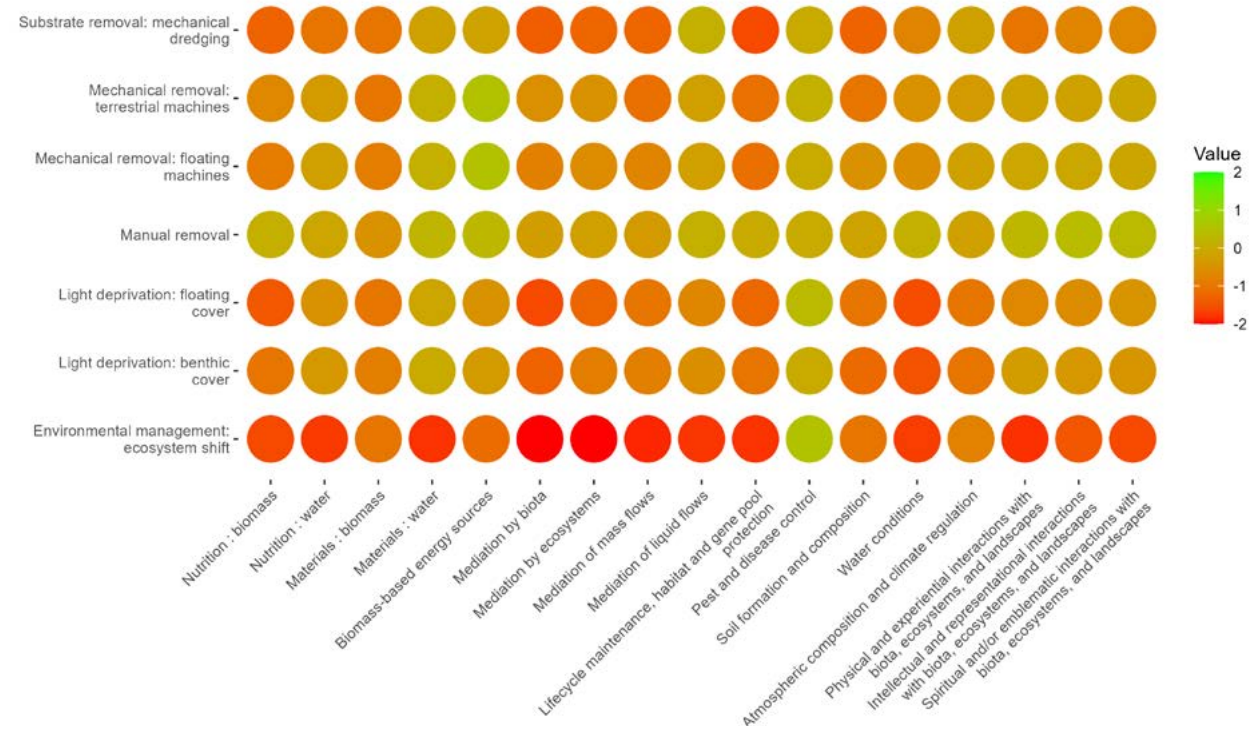

Fig 11. Matrix displaying the impact of management methods for aquatic plant species on ecosystem services after 1 year

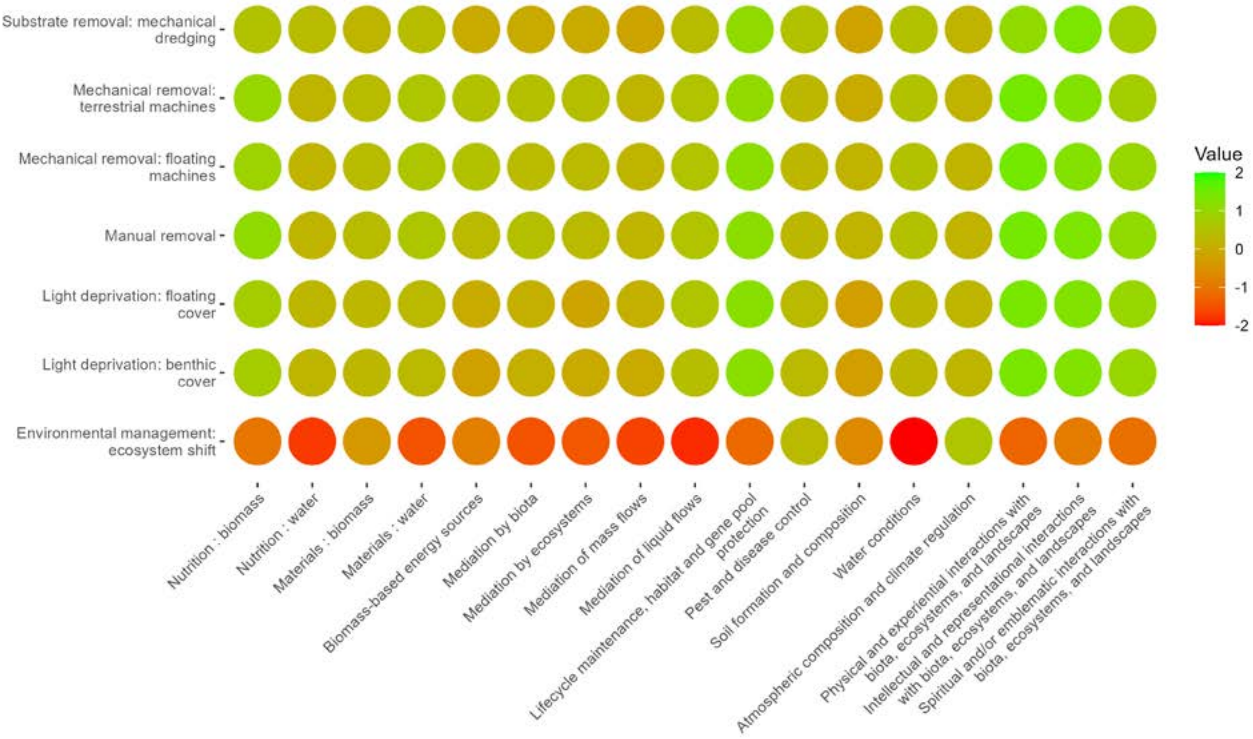

Fig 12. Matrix displaying the impact of management methods for aquatic plant species on ecosystem services after 5 years

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