LIFE Resilias

Preventing dominance of invasive alien species by strengthening the resilience of forest and nature




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Publication: Bosgroep Zuid Nederland and Stichting Bargerveen
Authors: Babette Saris, Petra Schmitz en Janneke van der Loop
Translation: Laura van Veenhuisen
Design: Aukje Gorter
Photos: Bart Nyssen, Janneke van der Loop, Martijn van de Loo, Paul van Hoof, Rob van der Burg, Jan den Ouden, Ron Rijken, Hein van Kleef, Aukje Gorter, Hans van den Bos, WikimediaCommons, PxHere

About LIFE Resilias

Various exotic plant and animal species, or alien species, can be found in European forests and other nature reserves. These animals and plants have been introduced consciously or unconsciously and are outside of their native range. A small proportion of these species behave invasively. This means that the alien species spreads after establishment at the expense of the local native species. This can pose a serious threat to biodiversity and thus the functioning of an ecosystem. These Invasive Alien Species (IAS) are often difficult to control and displace native animal species and vegetation. They also make it more difficult to achieve nature objectives and combating these IAS makes nature management more complex and expensive. However, there is another way which is demonstrated by the LIFE Resilias project.

LIFE Resilias

LIFE Resilias is a joint project of project partners Bosgroep Zuid Nederland and Stichting Bargerveen. The project started in 2021 and has a duration of 7 years. LIFE Resilias was made possible thanks to funding from the European LIFE-program (LIFE19 NAT/NL/000821) and various sponsors.

An innovative approach

In LIFE Resilias we consciously choose not to fight the invasive species endlessly, but make it effectively and efficiently manageable with a 'system-based approach': the ecosystem approach. This is done by enhancing the resilience and diversity of the entire ecosystem, which breaks and prevents dominance of IAS.

Examples from the field

The ecosystem approach can be applied to many different invasive alien species, each in their own ecosystem. As examples the project focuses on four IAS in different ecosystems, different habitats. A specific approach has been developed for each of these examples, which is demonstrated in practice and is monitored during the project. What is required for the approach and how do you do it?

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The ecosystem approach

The ecosystem approach in a nutshell

The basic principle of the ecosystem approach is to strengthen the resilience of ecosystems, so that eventually the system itself ensures that the invasive alien species can no longer dominate. The increased resilience also reduces the chance that ecosystems will be invaded by new invasive species. Strengthening the resilience is done by introducing native species that compete with the existing and possible new IAS by influencing growth factors. This involves, for example, the availability of light or nutrients that become limited to the IAS due to the competition with native species. The unwanted invasive species is pushed back and has less chance to expand or (re)establish itself.

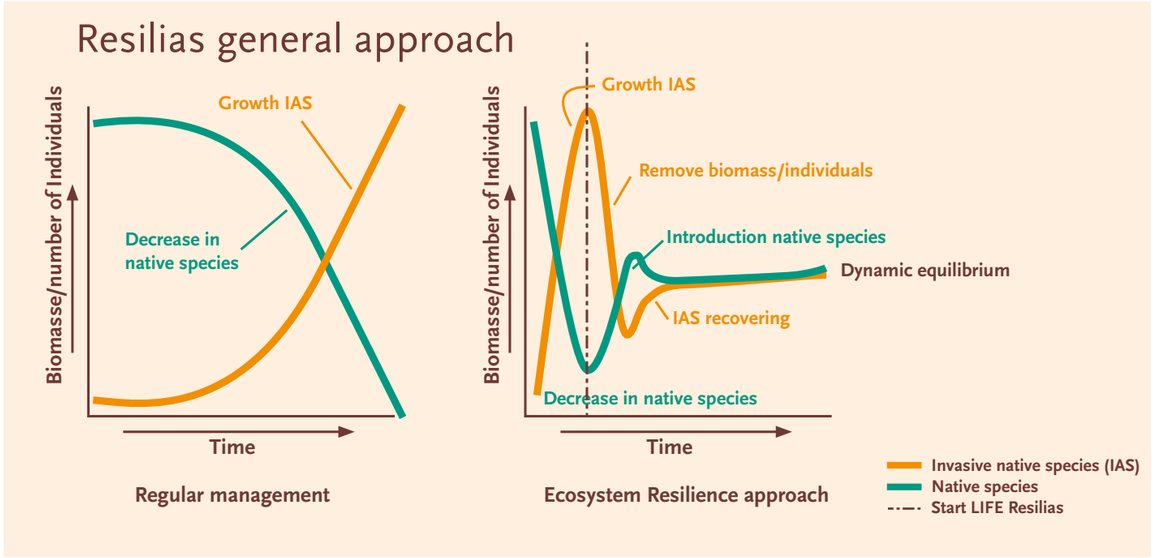
Traditional approach of IAS versus LIFE Resilias

The traditional approach to IAS as we know from regular management often proves to be ineffective. It is generally accompanied with damage to the native species composition. For example, when big equipment is used or when pools are pumped dry, it also affects native species. The damaged and disturbed area in turn provides ideal conditions for recolonization of the targeted IAS, of which fragments or seeds are left behind. This means that, over time, there is usually an increase in the invasive alien species, at the expense of the native flora and fauna which usually have lower growth rates.

The concept

The concept of enhancing ecosystem resilience (Ecosystem Resilience Approach, ERA) is based on the observation that undisturbed species-rich communities suffer less from invasions than species-poor communities that were recently disturbed. Ecosystems with maximum occupancy of native species, with both flora and fauna make optimal use of the available resources, such as space, light and nutrients. Leaving little resources for new non-native species. This provides resilience against invasions of alien species. In resilient ecosystems, new species have a minimal chance of establishing and becoming dominant.

The traditional complete removal of invasive alien species by excavating causes a lot of damage to the ecosystem. (Photo: Janneke van der Loop)



Schematic representation of the LIFE Resilience approach. (Figure: Janneke van der Loop)

LIFE Resilias intervenes by breaking the dominance of the IAS while simultaneously stimulating native species in the same location or by introducing natural enemies of the IAS. This makes the ecosystem previously affected by IAS less vulnerable to (re)colonisation with invasive species (see the dotted line in the figure above where LIFE Resilias intervenes in the invasion process). Due to the decrease in the IAS and the increase in native species, a so-called 'ecological arms race' is arising, in which the IAS reaches a balance with native species, or even continues to decline in number and/or biomass.

De ecosystem approach in LIFE Resilias

LIFE Resilias demonstrates the translation of this concept to the management of IAS in practice. The development of more resilient ecosystems is done by strengthening the competitive position of the desired species at the expense of the unwanted species. This can be achieved by:

1. Influencing growth factors such as available nutrients and light, to achieve competitive advantage for the desired species.
2. Introducing or supporting missing desired native species, in particular species that compete with the expected or already present IAS.
3. Removing as much biomass as possible from

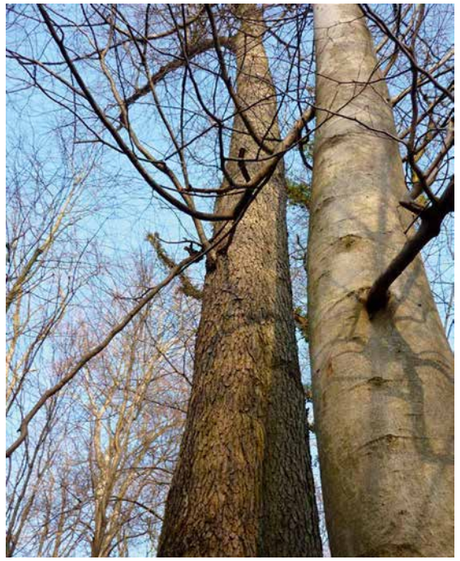
the IAS often contributes to the competitive position of the desired species. This is then, of course, performed prior to the introduction of these species.

Eradication does not work, managing does

Where regular IAS management is focused on combating and eradicating unwanted species, LIFE Resilias adds actions that enhance the resilience of ecosystems. An innovative approach in line with IAS Regulation 1143/2014/EU, which states that prevention of establishment is one of the ways to counter IAS. This new approach has been successfully tested on an experimental or pilot scale for a number of IAS, including black cherry (*Prunus serotina*), pumpkinseed sunfish (*Lepomis gibbosus*), Australian swamp stonecrop (*Crassula helmsii*) and Asian knotweed (*Fallopia spp.*) in in their respective ecosystems.

The introduction of native vegetation to make a system more resilient to Australian swamp stonecrop. (Photo: Ron Rijken)

An adult black cherry tree (left) next to a beech. (Photo: Bart Nyssen)



Project approach LIFE Resilias

In practice; experiences and principles per habitat

Forest

In forests, LIFE Resilias demonstrates how to enhance ecosystem resilience against black cherry dominance by planting fast-growing and shade-tolerant native tree species. Fast-growing pioneer tree species grow above the black cherry and shade-tolerant species establish themselves below the IAS. Over time, the black cherry will lose in the competition for light.
This has been successfully tested on experimental and pilot scale in the Netherlands, Flanders (Belgium) and Germany. Scientific studies also confirm the effect of the ecosystem approach for black cherry in forests. Resilience to dominance by black cherry can be seen in several EU countries. These are specific parts of vulnerable forests that have become resilient through management in the past.

In full light, birch and larch grow above black cherry. (Photo: Bart Nyssen)

Brook valleys

LIFE Resilias also focuses on competition for light in brook valleys. This is about strengthening the resilience of the ecosystem against Asian knotweed. This is done by planting native trees, such as willows (*Salix spp.*) or black alder (*Alnus glutinosa*) and shrubs. First, it is important to remove most of the underground rhizomes of the Asian knotweed to give introduced native species sufficient time and space to establish themselves. In northern France, the effectiveness of increasing ecosystem resilience against Asian knotweed was successfully tested in a field trial. In this experiment, planting of willow and alder reduced knotweed expansion and growth by 50% and 80%, respectively.

Grasslands

In herbaceous ecosystems, such as grasslands, LIFE Resilias uses competition for nutrients to enhance ecosystem resilience. This has been tested for Asian knotweed in small field experiments

Plots for testing the competition of native vegetation against Australian swamp stonecrop. (Photo: Janneke van der Loop)

in grasslands. After root removal, introduced native herbs and grasses completely suppressed Asian knotweed regrowth within six months. In the experimental plots without introduced native species, the IAS continued to sprout and grow. In this experiment, the stunted growth of Asian knotweed appeared to be the result of competition for nutrients and increased feeding by herbivores that found shelter in the more diverse vegetation. Field observations suggest that some shrubs such as brambles (*Rubus spp.*) are also strong competitors for Asian knotweed species (personal observation M. van de Loo, Soontiëns Ecology). Planting vegetation that overshadows the knotweed and grows all year round is therefore part of the ecosystem approach in grasslands.

Introducing native vegetation to control Australian swamp stonecrop. (Photo: Janneke van der Loop)

Wetlands

Competition for nutrients can also serve to restore ecosystem resilience in low productive wetlands. Field observations show that a variety of native species can compete with the highly invasive Australian swamp stonecrop. This has been confirmed in laboratory experiments, in which the establishment and growth of the IAS was suppressed by native species including American shoreweed (*Littorella uniflora*). Additionally, reducing the availability of nutrients makes it possible to control this invasive species in wetlands.

Competition plays much less of a role for animal species when it comes to the resilience of ecosystems to invasive animal species. The aggressive behaviour of invasive fauna can mean that native species are chased away and competition will therefore not increase resilience. Here it is predation aimed at the invasive species that works. Native predators are able to enhance the resilience of ecosystems because they prey on the invasive animals. This has proved successful for stone moroko (*Pseudorasbora parva*), a small freshwater fish. In this experiment in ponds, the stone moroko abundance was greatly reduced by pike (*Esox lucius*), while no effects on native fish species were found.
Field observations suggest that pike can also suppress invasions of pumpkinseed sunfish. This has been confirmed in large-scale pilots where pike was introduced after a single catching event of sunfish. Recovery of the IAS population was prevented and the pumpkinseed sunfish populations decreased permanently by over 90% (Data Stichting Bargerveen).

Getting started with four IAS as examples

In LIFE Resilias focuses on four IAS in different habitats:

- Black cherry (*Prunus serotina*) in forest
- Asian knotweed (*Fallopia* spp.) in brook valley forests and grassland
- Australian swamp stonefish (*Crassula helmsii*) in wetlands
- Pumpkinseed sunfish (*Lepomis gibbosus*) in wetlands

Releasing pike as a native predator against pumpkinseed sunfish. (Photo: Hein van Kleef)

Black cherry – *Prunus serotina*

SPECIES DESCRIPTION

Black cherry	*Prunus serotina*
Names	Nederlands: Amerikaanse vogelkers Français: Cerisier tardif Deutsch: Späte Traubenkirsche
Origin	North America
Occurence	Common in Europe, mainly on sandy soils
Characteristics	Tree of the Rosaceae family, blooms with white flowers
Habitat	As undergrowth in light forests or as shrubs in forest edges
Negative effects	Preventing succession, displaces native species
Management difficulties	Long term and high costs, often not effective

The black cherry thrives in European forests and nature areas and is mainly known as undergrowth in light forests or as a shrub in forest edges. This shrub form is the result of growing in the shade and regular felling in an effort to control the species. However, the black cherry can develop into an impressive tree with sufficient light. It is clear now that combating black cherry does not only require a lot of time and financial resources, but it is also not always successful. By viewing this issue from the ecosystem approach, it is possible to work towards a balance. A situation where the black cherry is not a threat to the native forest ecosystem, but may even be a valuable asset.

When does the black cherry become dominant?

Dominance of invasive tree species in forests is possible because those forest ecosystems are depleted. These forests are often even-aged forests consisting of just a few tree species whose crowns allow a lot of light to pass through, like Scots pine (*Pinus sylvestris*). Invasive tree species – such as black cherry, northern red oak (*Quercus rubra*), black locust (*Robinia pseudoacacia*), and tree of heavens (*Ailanthus altissima*) – are pioneers taking advantage of this excess of light to establish and expand. Mature forest ecosystems, on the other hand, consist of many tree species, both pioneers and successor species. The latter can usually settle in low light conditions and create a lot of shade when maturing. In addition, these forests contain trees and shrubs of different ages, creating a layered forest structure that prevents most light from falling on the forest floor.

The ecosystem approach; black cherry

The ecosystem approach against black cherry in forests is to promote the succession of current forests to more mature forest by reintroducing the missing pioneer and successor tree and shrub species. Small-scale forest management is important here. This approach reinforces the stratification of the forest and prevents large amounts of light from stimulating the rejuvenation of the invasive tree species. This increases the resilience of the forest ecosystem and makes IAS less likely to disrupt the system. Small-scale forest management consists of avoiding large-scale logging, targeted rejuvenation, selection in the rejuvenation (cutting and breaking) and the selection and stimulation of future trees. This provides the forest manager with tools to regulate the share of invasive tree species in the transition period to mature resilient forests.

Suitable species to reintroduce are shade-tolerant trees. For example; small-leaved lime (*Tilia cordata*), European hornbeam (*Carpinus betulus*), common beech (*Fagus sylvatica*), maple (*Acer spp.)* and European white elm (*Ulmus laevis*). Fast-growing trees such as aspen (*Populus tremula*), birch (*Betula spp*.) and willow (*Salix caprea*) are also suitable species.

Scan the QR-code for more information regarding the black cherry.

Asian knotweed – *Fallopia spp.*

SPECIES DESCRIPTION	
Staudenknöterich	*Fallopia* spp.
Names	Nederlands: Aziatische duizendknoop Français: Renouée Asiatique Deutsch: Asiatischer Staudenknöterich
Origin	Asia, a.o. Japan
Occurence	Common in Europe
Characteristics	Deep rooting, perennial, with long stems of 0.5 – 3 m long
Habitat	In groups on nutrient-rich moist soils. Shade tolerant but prefers full sun
Negative effects	Displaces native species. Damage to buildings, pipes, dikes, pavements, etc.
Management difficulties	Long term and high costs, often not effective

There are several species of Asian knotweed with invasive characteristics. Such as *Fallopia japonica* and *Fallopia sachalinensis*. The ecosystem approach of Asian knotweeds is demonstrated by LIFE Resilias in two different habitat types; in brook valley forests and in grasslands or roadsides, where high densities of Asian knotweeds are found.

The ecosystem approach; Asian knotweed in brook valley forests

Brook valley forests are species-rich forests with an exuberant spring bloom of, among others, wood anemones (*Anemone nemorosa*) and oxlip (*Primula elatior*). However, this species richness is threatened by desiccation and displacement by IAS such as Asian knotweed and Himalayan balsam (*Impatiens glandulifera*). These IAS can spread easily along the brooks and find good growing conditions in the rich moist subsoil to expand invasively.
In brook valley forests, invasive plant species can form dense vegetation because the forests are relatively translucent. They are often planted even-aged forests consisting of tree species such as common oak (*Quercus robur*) and poplar (*Populus spp.*), whose crowns allow a lot of light to pass through to the forest floor. The dense up to three meter high vegetation of Asian knotweeds prevents the establishment of young trees and shrubs after introduction. Well-developed brook valley forests, on the other hand, consist of several tree layers of different tree and shrub species. Native forest plants can survive in these shady conditions, but it is too dark for fast-growing IAS. The Asian knotweeds can survive in shade for a few years, but the plants will become less vital and dense over time.
Here, the ecosystem approach consists of first reducing the Asian knotweed population in order to create a good starting situation. Therefore, step 1 is the mechanical excavation and removal of as many Asian knotweed rhizomes as possible to a depth of approximately 40 cm. After that, fast regrowth of the IAS is prevented by removing emerging sprouts manually, several years in a row. The next step is to increase the shade pressure by introducing tree and shrub species that occur naturally in brook valley forests. These are shade-tolerant trees, such as small-leaved lime (*Tilia cordata*), large-leaved lime (*Tilia platyphyllos*) and common hornbeam (*Carpinus betulus*). In lighter spots, sweet cherry (*Prunus avium*), willow (*Salix spp.*) and aspen (*Populus tremula*) are good choices. This reinforces the stratification of the forest and prevents the establishment and expansion of Asian knotweeds.

The ecosystem approach; Asian knotweeds in grassland and road sites

Grasslands are extremely important for European nature and biodiversity. Even the grasslands alongside the many roads are a home for all kinds of flora and fauna. Due to their enormous length and semi-natural character, these grasslands have the potential to form an important habitat for insects, which have a difficult time living in the intensively used rural area.
Grasslands mean biotopes with almost exclusively herbaceous plants, such as daisies (*Leucanthemum spp.)* and Yorkshire fog (*Holcus lanatus*). With grazing or mowing, the vegetation in grasslands is reset once or several times a year. As a result, no woody species grow in grasslands.

A population of the invasive species Asian knotweed. (Photo: Martijn van de Loo)

Management creates a lot of open space in these areas, favouring Asian knotweeds to develop and spread quickly. The invasive species benefits from high nitrogen concentrations and the open spaces created in the native vegetation by intensive mowing. Traditionally Asian knotweed control mainly consists of mowing, grazing, and uprooting the plant. Complete elimination is almost impossible because plant fragments that are left behind will eventually lead to the recovery of the IAS population. In addition, current control methods create a situation with little natural resistance to IAS.

In grasslands too, efforts are made to break the dominance, by removing Asian knotweeds and increasing resilience through competition, for light and nutrients between Asian knotweeds and native vegetation. This is possible by replenishing and restoring populations of native species in these grasslands, such as bramble (*Rubus spp.*) and native herb mixtures. These species offer resistance to the Asian knotweeds in the long run.

Scan the QR-code for more information regarding Asian knotweeds.

Australian swamp stonecrop – *Crassula helmsii*

SPECIES DESCRIPTION	
Nadelkraut	*Crassula helmsii*
Names	Nederlands: Watercrassula Français: Orpin de Helms Deutsch: Nadelkraut
Origin	Australia
Occurence	Common in European wetlands, occurs more often on sandy soils
Characteristics	Hardy succulent plant, pioneer, (5-25cm) with three growth forms: terrestrial, submerged aquatic and floating
Habitat	Humid locations including waterways, pools and fens
Negative effects	Displaces native species, closes up the water layer, changes water quality
Management difficulties	Spreads through small fragments, rapid regrowth

Australian swamp stonecrop grows explosively in pioneering situations with open spaces which are enriched with nutrients, such as sodded areas on former agricultural lands. The plant can withstand drought well and is therefore also a danger for moist areas that regularly fall dry. In practice, complete elimination of Australian swamp stonecrop is often not feasible or very expensive.

The ecosystem approach; Australian swamp stonecrop

That is why LIFE Resilias' ecosystem approach focuses on controlling this exotic species by breaking the dominance and stimulating the native species to create a balance.

Step 1 is to reduce the presence of Australian swamp stonecrop over 95% by excavating the population mechanically. Where possible, the eutrophication sources are adapted to reduce the available nutrients in the ecosystem. This is followed by the introduction of native competitors that match the habitat conditions of the ecosystem. These come from donor locations or plant breeding facilities. This hinders the regrowth of Australian swamp stonecrop and prevents a dominant establishment by this IAS. Depending on the growth habit of the desired native species, seeds, rooting fragments or whole plants can be used. The choice of native species depends on location and changes in the degree of annual inundation, soil conditions and the objectives of the area.

Removal of biomass from the invasive Australian swamp stonecrop by covering the IAS. (Photo Janneke van der Loop)

Scan de QR-code for more information regarding Australian swamp stonecrop.

Photo's: Paul van Hoof

Pumpkinseed sunfish – *Lepomis gibbosus*

SPECIES DESCRIPTION	
Sonnenbarsch	*Lepomis gibbosus*
Names	Nederlands: Zonnebaars Français: Perche-soleil, crapet-soleil Deutsch: (Gemeiner) Sonnenbarsch
Origin	North America
Occurence	Common in European wetlands, with the exemption of the Nordic and Baltic countries
Characteristics	Freshwater fish (15 cm) with rapid reproduction and versatile diet The young fish live in schools, adults are solitary and territorial
Habitat	Small enclosed, more or less natural waters on sandy soils
Negative effects	Feeds on, among others, macrofauna, fish, amphibians and occasionally aquatic plants
Management difficulties	Difficult to catch all individuals, fast population recovery

Wetlands are often disturbed by an excess of nutrients, acidification and desiccation. Nature managers encourage vulnerable pioneer systems with low species density (in both vegetation and, for example, fish stocks) to facilitate protected species such as natterjack toads (*Epidalea calamita*), causing the resilience of wetlands against IAS to decreases even further.

The ecosystem approach; pumpkinseed sunfish

The dominance of pumpkinseed sunfish can be broken by catching as many individuals as possible and then actively introducing natural enemies such as pike (*Esox lucius*). The pike prey on the remaining invasive pumpkinseed sunfish and thus contributes to reducing the IAS population and keeping it low.

Scan de QR-code for more information regarding the pumpkinseed sunfish.

Using the pike as a natural enemy to manage the pumpkinseed sunfish. Photo: WikiMedia Commons

Explain, demonstrate and translate to other invasive alien species

Sharing knowledge

By explaining and demonstrating the ecosystem approach of different IAS in various habitats, LIFE Resilias shows forest and nature managers/ owners an alternative to regular IAS control. The project also provides guidelines and information on how they can use this approach in their own areas.
Knowledge sharing takes place in many ways. For instance through symposia, presentations, excursions, articles and publications and of course through our website and social media platforms.

Translation to other invasive alien species

In addition to the species and habitats mentioned, LIFE Resilias will also experiment with the ecosystem approach for other IAS. Based on knowledge, experience, literature and sometimes even the first experiments, it is often possible to give direction to the best way to set up the ecosystem approach. As for heath star moss (*Campylopus introflexus*) in dry and shifting sands; Invasive crayfish (*Oronectus spp., Procambarus spp., and Pacifastacus spp.*) in pools and the northern red oak (*Quercus rubra*) and black locust (*Robinia pseudoacacia*) in forests. For these combinations, the project team will take a closer look at what the ecosystem approach for these species can look like through literature study, field visits and experiments and how you can make the ecosystems where these species occur more resilient. For the tree of heavens (*Ailanthus altissima*) in forest, LIFE Resilias investigates how a successful ecosystem approach can prevent the species from becoming invasive. The goal in this case is prevention.

Partners and Sponsors

LIFE Resilias is an initiative from project partners Bosgroep Zuid Nederland and Stichting Bargerveen.

Bosgroep Zuid Nederland
– Forest and nature management: from advice to implementation

Bosgroep Zuid Nederland is an independent non-profit organisation. The members are owners of forest and nature areas in the southern part of the Netherlands. The focus is on sustainable management, restoration and development of forests and nature; from substantive advice to vision creation, acquisition of grants, work preparation and the supervision of activities in forests and nature. The strength of Bosgroep Zuid Nederland lies in the combination of specialised professional knowledge and the expertise and experience to realise and monitor these ambitions in the field.

Bosgroep Zuid Nederland
Huisvenseweg 14
5591 VD Heeze
+31 (0)40 20 66 360
www.bosgroepen.nl

Stichting Bargerveen
– For ecosystem restoration

Stichting Bargerveen is an independent non-profit organisation established in 1993 with the aim of supporting nature management and restoration with ecological knowledge. The work focuses specifically on sustainable restoration and conservation of nature. Through scientific research, management experiments and monitoring, ecological knowledge is derived and translated into practice in close cooperation with site managers. The advice on restoration, development and management of nature areas is always tailor-made and evidence based.

Stichting Bargerveen
Natuurplaza (Mercator III)
Toernooiveld 1
6525 ED Nijmegen
+31 (0)6 47 28 09 23 (Secretariaat)
www.bargerveen.nl

Sponsors

LIFE Resilias is made possible thanks to the sponsors, all of whom support and endorse the ecosystem approach and have therefore committed themselves to the project.

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A LIFE Programme

LIFE Resilias has received funding from the LIFE programme of the European Union. A grant with the aim of supporting innovative projects that fit in with European nature, environment and climate policy, and that further develop or put this policy into practice.

More information regarding LIFE can be found on the website of the European Union.
https://cinea.ec.europa.eu/life_en

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Would you like to get started with the ecosystem approach?

Are you also curious about the possibilities of the ecosystem approach? One of the ambitions of the project is to make the ecosystem approach philosophy finds its way to as many people as possible who are dealing with IAS and would like to tackle it in a natural and effective way.
If you manage or know an area in which you would also like to apply the ecosystem approach, please do not hesitate to contact us to discuss the options.

- **Black cherry**
  Bart Nyssen, Bosgroep Zuid Nederland,
  b.nyssen@bosgroepen.nl

- **Asian knotweeds**
  Janneke van der Loop, Stichting Bargerveen
  j.vanderloop@science.ru.nl
  Rob van der Burg, Bosgroep Zuid Nederland
  r.vanderburg@bosgroepen.nl

- **Australian swamp stonecrop and pumpkinseed sunfish**
  Janneke van der Loop, Stichting Bargerveen
  j.vanderloop@science.ru.nl
  Laura van Veenhuisen, Stichting Bargerveen
  l.vanveenhuisen@science.ru.nl

Seedling of Asian knotweed. (Photo: PxHere)

More information

On our website www.resilias.eu you can find all updated information regarding the project as well as news messages. The frequently asked questions section on our website might already contain some of the answers to questions you may have. Please feel free to contact us if you have further questions at:
info@resilias.eu

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