Länsstyrelsen Skåne

SemiAquatic Life

Ecosystem services provided by SemiAquatic Life, 2016–2021

Titel:	Ecosystem services provided by SemiAquatricLife, 2016-2021
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Pre-word

This report presents ecosystem services provided by the actions conducted within the Life project “SemiAquatic Life - Recreating habitat complexity for semi-aquatic fauna”. The project has been running between 2016-2021 with the aim of restoring and improving the conservation status of amphibians, reptiles, and aquatic insects in Natura 2000 areas in southern Sweden (11 areas), Denmark (15 areas), and northern Germany (9 areas). The aims of the project have been to ensure viable metapopulations of species listed in Annex II-V of the EU Species and Habitats Directive, but also to increase public awareness and understanding of the need for restoration measures for semi-aquatic insects, amphibians, and reptiles.

The created wetlands in the project have had a positive effect on several ecosystem services. For regulating services, increased nutrient retention and reduced risk of flooding due to establishment of new wetlands are the most important services. According to our calculations, the project has generated a reduction of nitrogen by about 4 900 kg per year and about 120 kg of phosphorous per year. For cultural services, increased human well-being and increased appreciation of local biodiversity are important results. Thus, SemiAquatic Life has contributed not only to biodiversity but also to several important ecosystem services.

Ingela Lundqvist

Head of Nature Conservation unit, County Administrative board of Scania

Content

Summary

This report presents ecosystem services provided from the actions conducted within the Life project "SemiAquaticLife - Recreating habitat complexity for semi-aquatic fauna". The project has been running between 2016 and 2021 with the aim of restoring and improving the conservation status of amphibians, reptiles, and aquatic insects in Natura 2000-areas in southern Sweden (11 areas), Denmark (15 areas), and northern Germany (9 areas). The aims of the project have been to ensure viable metapopulations of species listed in Annex II-V of the EU Species and Habitats Directive, but also to increase public awareness and understanding of the need for restoration measures for semi-aquatic insects, amphibians, and reptiles. Within the project 243 new wetlands have been created, corresponding to an area of 24.40 ha and 228 wetlands have been restored corresponding to an area of 40.02 ha. In addition to this, terrestrial habitats for herptiles have been improved by creating 109 hibernations and clearance of predominantly invasive bushes corresponding to an area of 376 ha. Furthermore, several information signs about the project and its target species have been placed in project areas. Other information actions have been Webpage, Facebook page, information leaflets, excursions, and an outdoor museum.

In this report the projects effects on ecosystem services are presented. The results of surveys concerning visitors experience of project actions in two case study areas in Sweden are also presented. Furthermore, biodiversity in constructed wetlands (i.e., a supporting ecosystem service) in five project areas in Scania and Denmark has been evaluated.

In summary, the results show that the project has had a positive effect on several ecosystem services. For regulating services, increased nutrient retention and reduced risk of flooding due to establishment of new wetlands are the most important services. For cultural services, increased human well-being and increased appreciation of local biodiversity are important results. This is also shown in the ecosystem services analysis (using the tool ESTER) carried out at the two sites with complementary data from visitors also were collected. In these two areas, the project actions show a positive effect on most ecosystem services. Overall, the biodiversity in the monitored wetlands is still rather low, but scores for amphibians and reptiles are relatively high for several wetlands. However, the biodiversity and the physical potential for wetlands to promote biodiversity in the constructed wetlands within the LIFE project, show similar results compared to other constructed wetlands (e.g., within the Rural Development Program) in the agricultural landscape.

Background and aim

Within the Life project" SemiAquatic Life – Recreating habitat complexity for semi-aquatic fauna" several actions have been conducted to improve the conservation status of herptiles and aquatic insects at Nature 2000-areas in Sweden (11 areas in Scania), Denmark (15 areas) and northern Germany (9 areas) (figure 1). The overall aim of the project has been to ensure viable metapopulations of species listed in Annex II-V in the Species and Habitats directive (Council Directive 92/43/EEC of 21 May 1992, on the conservation of natural habitats and of wild fauna and flora). Another goal has been to increase the understanding among stakeholders and the public for the necessary actions urgently needed for these organisms. The project was running between 2016-2021 and partly financed by EU Life Nature (Project LIFE14NAT/SE/000201).

This report summarizes the ecosystem services (ES) provided at the end of the project. The results presented are based on several methods and recommendations found in different documents. Firstly, lists of the services provided are presented based on the recommendations by the Swedish Environmental Protection Agency (Naturvårdsverket, 2017). These recommendations are based on CICES (Common International Classification of Ecosystem Services, see below for more details). Secondly, results from a more in-depth analysis of different services from two case study areas in Sweden are shown. Finally, improving biodiversity was an important goal of the project, and this supporting ecosystem service (see definitions below) is fundamental for producing other services. Subsequently, we show the results of biodiversity assessments of multiple created and restored wetlands across countries.

Figure 1. Location of the Nature 2000-sites in the project" SemiAquatic Life – Recreating habitat complexity for semi-aquatic fauna".

Ecosystem services (ES) – SemiAquaticLife and EU strategies

Ecosystem services (ES) can be defined as those services that nature provide and that contribute to our well-being. Even though this definition may be perceived as a bit vague, it can also be explained by all the processes and products that involves living organisms that humans appreciate.

According to the Swedish Environmetal Protection Agency, ES should be divided and defined as follows:

- Provisioning (e.g., production of crops, fisheries, drinking water, timber)
- Regulating/maintenance (e.g., nutrient retention in wetlands, pollination, carbon storage in forests)
- Cultural (e.g., bird watching, recreation, picking mushrooms)

It should also be stressed that there is another category of ecosystem services, the supporting services, but this ES has no direct benefit for human-wellbeing but is fundamental for all other services listed above. Examples of supporting services are biodiversity, primary production, and soil formation.

Several recent strategies and documents from the EU have been stressing the importance of promoting biodiversity and preserving ecosystem services. For example, the EU Biodiversity strategy to 2020 (as well as the strategy to 2030) acknowledges biodiversity to play a key role in securing human-wellbeing in EU, and with a new focus on the immense value of ecosystem services. The actions within SemiAquaticLife have contributed to the fulfilment of the targets of the EU Biodiversity Strategy to 2020. The strategy sets out 6 targets and 20 actions to halt the loss of biodiversity and ES in EU by 2020. The six targets are listed below and the contribution of SemiAquaticLife to these targets is indicated by yes/no as listed below:

1. Protect species and habitats - yes
2. Maintain and restore ecosystems - yes
3. Achieve more sustainable agriculture and forestry - no
4. Make fishing more sustainable and seas healthier – no (but yes for healthier seas)
5. Combat invasive alien species - yes
6. Help stop the loss of global biodiversity - yes

Apart from the EU Biodiversity Strategy to 2020 the actions within SemiAquaticLife have contributed to the fulfilment of other strategies in EU by providing a variety of ecosystem services. The creation and restorations of wetlands is in line with the Water Framework Directive by increasing nutrient retention (regulating/maintenance service, making seas healthier). Increased water holding capacity by creating wetlands is in line with the Flood Directive (regulating/maintenance service). Moreover, many of the nature 2000-areas in the project are often visited by tourists and actions such as creation of wetlands, clearing of bushes, removal of invasive species, and setting up information signs have increased the values of cultural

ES across the countries. This is also in line with the Commission communication:" Europe, the worlds No 1 tourist destination - a new political framework for tourism in Europe".

Below this report gives more concrete examples and details of the ES provided by SemiAquaticLife and the methods used to assess different ES.

Methods for scoring and assessing ecosystem services

There are several ways to assess ES e.g., qualitatively (words), semi-quantitatively (scores), quantitatively (physical units such as areas and kg) or in monetary terms (€). In recent years it has become more evident that assessing ES in monetary terms is less recommended and, in many cases, impossible or inappropriate (e.g., cultural services). Subsequently, monetary assessments of ES are less common today. There are several different methods to apply when assessing supporting and other services depending on the purpose of the evaluation and the level of ambition. It is quite common to use a proxy, for example to estimate the level of carbon storage in an area (regulating service), maps can be used to estimate the area covered by forest instead of making actual measurements on site. It is common to back up such approximations by using data on actual carbon storage from other studies.

CICES (Common International Classification of Ecosystem Services) is the recommended system to use when assessing and presenting results from ecosystem services analyses, and we have followed this, and the guidelines presented by the Swedish Environmental Protection Agency (Naturvårdsverket, 2017). In principle, the different services are first categorised into major sections (provisioning, regulation/maintenance, or cultural services) and then the hierarchical structure enables further classification into divisions and groups. However, CICES does not cover the supporting services (e.g, biodiversity). Rather supporting services are treated as part of the underlying structures, process and functions that characterise ecosystems. This is because supporting services are only indirectly consumed or used by humans.

When assessing the ES provided by SemiAquaticLife focus has been on using qualitative scores (present/absent) before and after the project. Two major approaches have been used to classify ES. First, we apply the guidance system suggested by the Swedish Environmental Protection Agency and then we use a tool called ESTER, developed by the Swedish National Board of Housing, Building and Planning. Thirdly, we assess the supporting services (biodiversity) based on investigations in multiple wetlands across the countries.

Ecosystem services provided in the project

Using to guidelines for assessment of different ES according to the Swedish Environmental Protection Agency SemiAquaticLife has not contributed to any provisioning services, but to several regulating and cultural services as well as supporting services (Table 1-3). These services are listed under each ES-section below and discussed in more detail.

Supporting services

Several supporting services have been generated during the project (table 1). The construction and restorations of wetlands have contributed to increased primary production, biogeochemical processes and increasing and promoting biodiversity, not at least of endangered species (figure 2).

Table 1. Supporting ES positively affected by the actions in SemiAquaticLife. Examples of benefits to human well- being are also given.

Ecosystem services	**Benefit**
Primary production	No direct benefit, but an important service for other services that create benefits
Maintenance of biogeochemical cycles	No direct benefit, but an important service for other services that create benefits
Maintenance of biodiversity	No direct benefit, but an important service for other services that create benefits and contributes to more resilient ecosystems
Maintenance of habitat	No direct benefit, but an important service for other services that create benefits

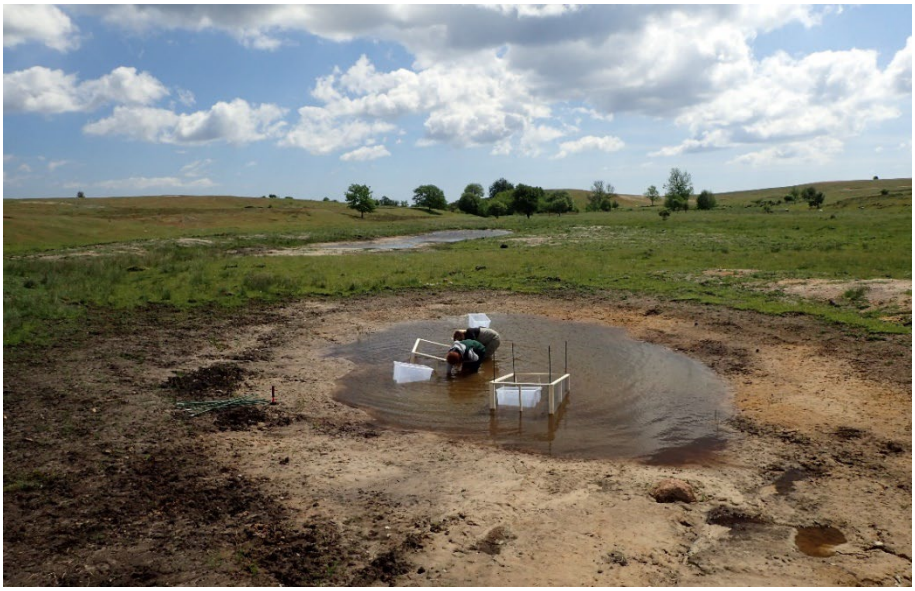


Figure 2. Cages at the project site Ravlunda skjutfält in Sweden used for stocking of eggs of the endangered natterjack toad.

Regulating/maintenance services

Within the project 243 new wetlands have been created corresponding to an area of 24.40 ha, and 228 wetlands have been restored corresponding to an area of 40.02 ha. The estimated total water holding capacity of all the 243 new wetlands in the project is estimated to be around 98 000 m^3.

Table 2. Regulating/maintenance services positively affected by the actions in SemiAquaticLife. Examples of benefits to human well- being are also given.

Ecosystem services	Benefit
Flood control	Decreased risk of flooding
Water purification	Improved water quality
Carbon assimilation	Reduced impact on climate change

In particular, the newly created wetlands (figure 3, table 2) are expected not only to increase the water holding capacity in the landscape, but also to increase nutrient retention and thereby also the transport to the sea. Applying the figures from the literature and the Swedish guidelines for nutrient retention in wetlands in the south of Sweden, i.e., 200 kg of nitrogen per ha and year and 5 kg of phosphorous per ha and year gives the retention capacity per year as follows. According to the calculations, the project has generated a reduction of nitrogen by about 4 900 kg per year and about 120 kg of phosphorous per year.

Figure 3. Four newly created wetlands at the project site Revingefältet in Sweden that contribute to several ecosystem services, including nutrient retention.

Wetlands are often efficient in binding carbon and may therefore act as carbon sinks and potentially reduce effects on climate change. The potential for the 243 newly created wetlands in the project to store carbon is therefore substantial. In Scania a total of 3.83 ha has been created and the corresponding figures for Denmark and Germany are 14.89 ha, and 5.68 ha, respectively.

Cultural services

SemiAquaticLife has contributed to several cultural ecosystem services across the countries (table 3). These seem mostly associated with e.g., health, experiences, and education. The newly created and restored wetlands have increased the potential for recreation and experiences from nature, including recovery. Wetlands are habitats the often are perceived as beautiful and restful. In addition to this, the possibility to hear amphibians as well as observing other fauna, including dragonflies is often appreciated. In the project, two areas in Sweden were further

investigated in order to get more information about how visitors perceived the actions conducted within the project. Two similar questionnaires were handed out to visitors at Löddeåns mynning (SE0430091) and Falsterbo skjutfält (SE0430111), both areas with comparatively many visitors, including tourists from other countries (more information about the sites and the results of these investigation can be found in a separate report on the socioeconomic effects of the project). According to the questionnaires (104 answers from Löddeåns mynning and 53 from Falsterbo skjutfält) the newly created wetlands had improved the experience of the visit to the area (figure 4).

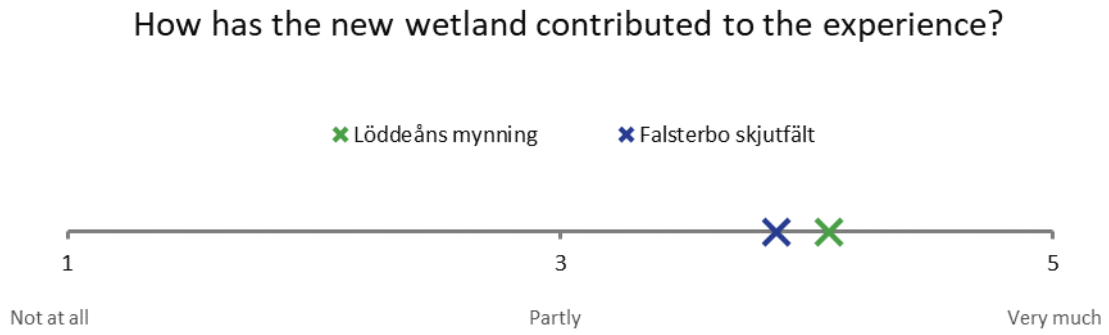


Figure 4. The impact of the newly created wetlands on the experience of visitors at the project areas Löddeåns mynning and Falsterbo skjutfält in Scania. Based on answers given in questionnaires (157 answers in total).

Table 3. Cultural ES positively affected by the actions in SemiAquaticLife. Examples of benefits to human well-being is also given.

Ecosystem services	**Benefit**
Characteristics of living systems that enable activities promoting health, recuperation, or enjoyment through passive or observational interactions	Sightings of wildlife
Characteristics of living systems that enable aesthetic experiences	Recuperation, inspiration, and relaxation
Characteristics of living systems that enable scientific investigation or the creation of traditional ecological knowledge	Scientific gaining of ecological knowledge
Characteristics of living systems that enable education and training	Knowledge of practical environmental management
Elements of living systems that have symbolic meaning	Social cohesion, spiritual satisfaction
Characteristics or features of living systems that have an existence value	Well-being because of knowing that habitat, or species, has the right to exist and be protected
Characteristics or features of living systems that have a bequest value	Well-being because of knowing that habitat, or species, are being preserved for the benefit of future generations

Pleasure can be included as a cultural ES and can be related to the knowledge that an area provides not only habitats for endangered species, but also the species themselves (figure 5). Here, the fact that also future generations will get the opportunity to also enjoy these species and their habitats may be particularly desirable. SemiAquaticLife has been focusing on improving the status of several endangered, protected, and rare species of herptiles and insects across Europe. The presence of such species and their habitats in an area may be regarded as symbolic representations for a society that care for nature and its natural ecosystems, many people may relate to this as very pleasant.

The actions within the project have also opened the opportunity for scientific investigations and increased knowledge about wetland ecosystems. Furthermore, new platforms for learning experiencing more about these aquatic ecosystems have been facilitated through several actions.

Figure 5. Pre-schoolers involved in stocking spadefoot toad tadpoles at a new wetland at Löddeåns mynning in Scania.

Assessment of ES at two case study sites using the tool "ESTER"

The National Board of Housing, Building and Planning in Sweden has developed a simple system for evaluating ES before and after actions using a qualitative approach by answering questions with yes or no (in most cases). It is also possible give answers about the ES in the future if they are expected to be desired or not. To help analysing ES, an excel file (in Swedish) can be downloaded from their home page. The tool is divided into major sections (supporting, provisioning, regulation/maintenance, and cultural services) with in total 22 different ES categories across these sections. In the file, you will have to answer 137 relevant questions in relation to each ES to assess the impact. The results will be presented in the tag "Data output" as ratios and percentages for each ES-category. The data in each category is the ES-points derived, divided by the maximum number of possible points (assuming you answer all questions by "yes"). These values should not be interpreted as an assessment of each ES, and different ES-

values should NOT be compared. Rather, the results should be used to give an overview of each ES before and after the project.

Then, when you have answered the questions, a graph (and a table) will be automatically generated for the user. In the graph there is a black dashed line appearing, representing the base line (percentages) for each category before the area is affected. Areas in grey indicate negative effects (assuming no compensation), light green indicate no effects, and dark green indicate positive effects. If you make compensations for lost ES a red line indicates values after compensation. There is also a compilation of future needs and deficiencies. If this value is higher than before the project, this highlights (orange bar) ES that could be important to consider even though the project itself does not have negative effects on them. We have applied ESTER at two case study areas, Löddeåns mynning (SE0430091), and Falsterbo skjutfält (SE0430111) in Scania.

For Löddeåns mynning the results of the different project actions show at least some positive effects for 13 of the 22 ES (figure 6). The most positive effects are shown for ecological interactions, habitats, and cycles (all supporting services). For the regulating/maintenance services most positive effects can be expected from improved regulation of local climate, protection against extreme weather, water purification and regulation. The only positive effects on provisioning services are increased water supply. For cultural services most are expected to be improved except cultural heritage and identity (Figure 6).

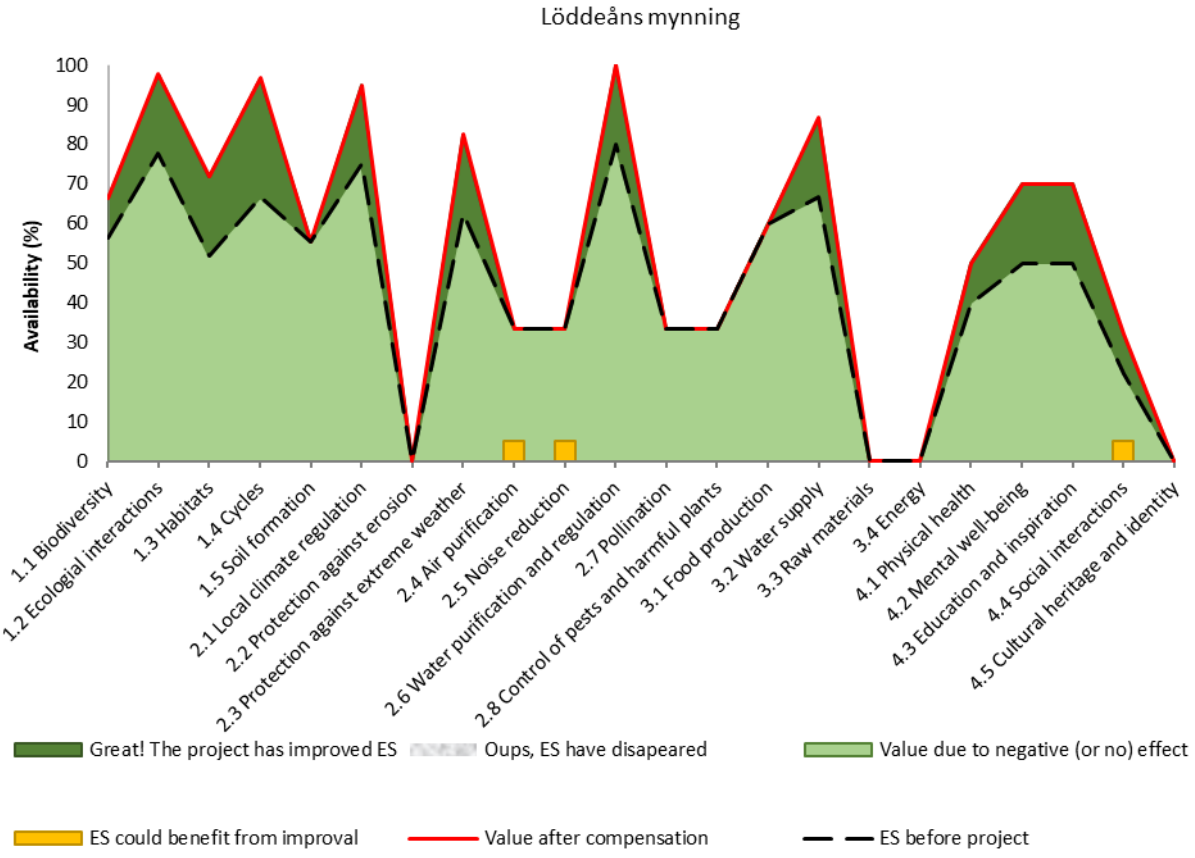


Figure 6. Estimated values (percentages) for each of the 22 ES across sections for Löddeåns mynning before (black dashed line) and after the actions made during SemiAquaticLife. Analyses based on the tool" Ester" provided by the National Board of Housing, Building and Planning in Sweden.

At Falsterbo skjkutfält, the analysis shows some positive effects on 9 of the 22 ES due to the actions completed within SemiAquaticLife (figure 7). For the supporting services, all effects are positive except for soil formation. For regulating/maintenance services positive effects are expected on local climate regulation, protection against extreme weather, and water purification and regulation. As for the result of Löddeåns mynning, the only positive effects on provisioning services are increased water supply. Cultural services are all positively affected except cultural heritage and identity.

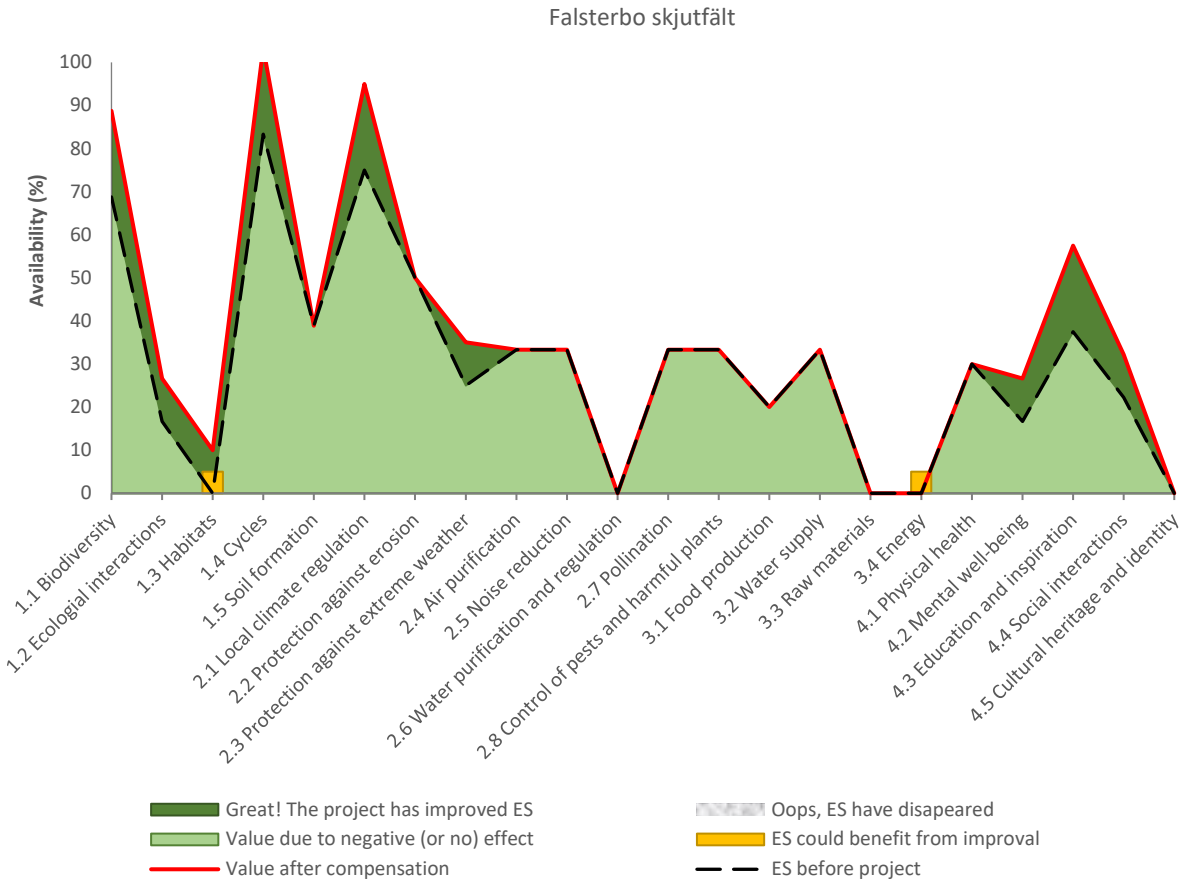


Figure 7. Estimated values (percentages) for each of the 22 ES, across sections for Löddeåns mynning before (black dashed line) and after the actions made during SemiAquaticLife. Analyses based on the tool" Ester" provided by the National Board of Housing, Building and Planning in Sweden.

Figure 8. An example of e new temporary wetland created at Falsterbo skjutfält in Scania.

Monitoring Biodiversity in wetlands

A major goal of SemiAquaticLife was to improve biodiversity in general for semiaquatic fauna at multiple nature 2000-areas in Scania, Denmark, and northern Germany. Biodiversity is an important supporting ES and therefore biodiversity at several constructed wetlands in the project was investigated further. There are several ways of investigating biodiversity in wetlands, and we have used a standardized method developed by the Swedish Board of Agriculture to give scores to different wetlands (Hassel, 2011). Overall, the method consists of two major areas of data collection. The physical- chemical characteristics of the wetland, and the biological characteristics of the wetland and its surroundings (within 100 m). Typically, a wetland is investigated once by a biologist during a summer day, and it will take about 1-2 hours to collect the data in the field for a wetland.

The physical parts give scores of the potential for the wetland to promote a high biodiversity and include estimations of wetland area, morphometry, land use within 100 m, distance to other wetlands and maintenance. High scores would typically be given to a large permanent wetland located in pasture and with other wetlands within dispersal distance for the semiaquatic fauna. Furthermore, wetlands not significantly acidified or polluted will also have the potential for high biodiversity.

The biological scores are based on observations of wetland birds (number of species and the presence of rare and vulnerable species), coverage of aquatic plants, invertebrate species richness (netting in vegetation + observations of flying dragonflies), amphibians (rare species give extra points as well as the presence larvae of the crested newt) and observations of crayfish and fish. In general, the presence of invasive species gives negative scores. The scores for the different components are then summarized. The maximum score is 25 for the physical and biological part, respectively.

In the summer of 2019, 23 wetlands within the project were scored at four project areas in Scania and one area in Denmark (figure 9 and 10). The survey was conducted by Emelie Karlsson, a master student at Lund university. To put the scores in a larger context the report also gives data from several other wetlands (47) that have been investigated in Scania using the same method (Hassel, 2011, Hertonsson et al., 2011). These wetlands were partly financed through the The Rural Development Programme (RDP). RDP is an EU Structural and Investment (ESI) Fund programme and a part of the rural development programme in Scania.

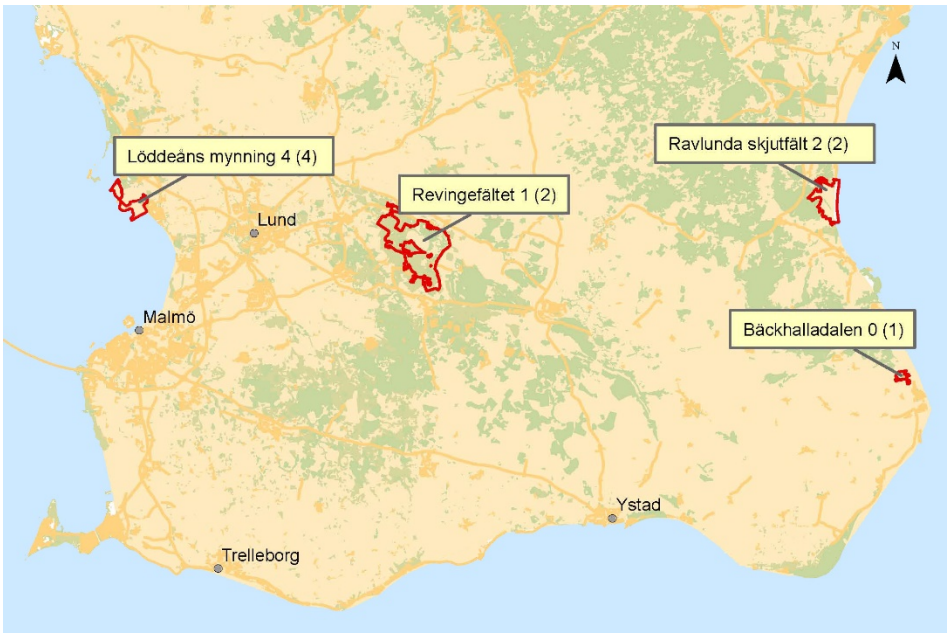


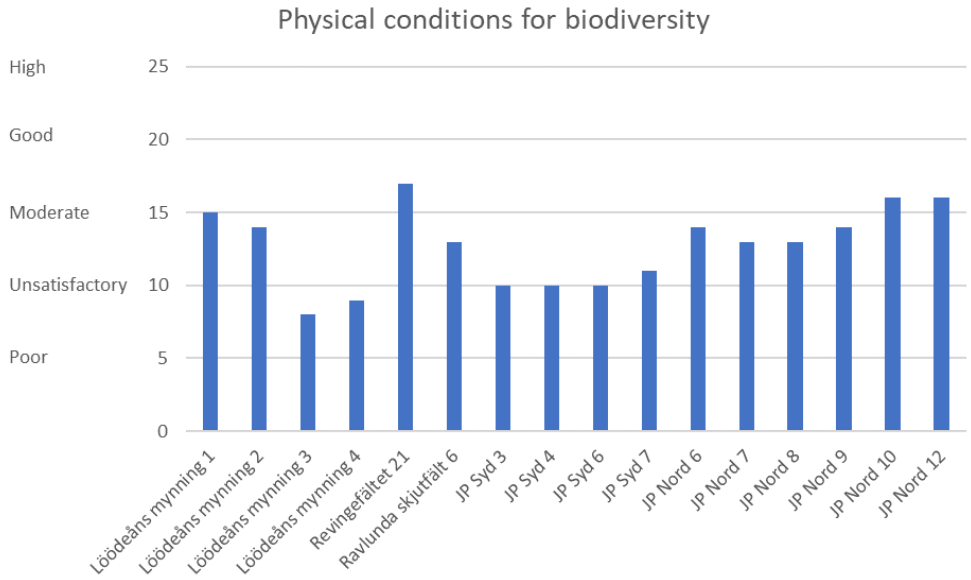
Figure 9. Map showing the four project areas in Scania where wetland biodiversity and the potential for biodiversity have been studied in more detail. Numbers within parenthesis refer to the actual number of wetlands investigated in each area. The wetlands investigated have been newly created.

Figure 10. Map showing the project area in Denmark where wetland biodiversity and the potential for biodiversity have been studied in more detail. Numbers within parenthesis refers to the actual number of wetlands investigated. The wetlands investigated have been newly created.

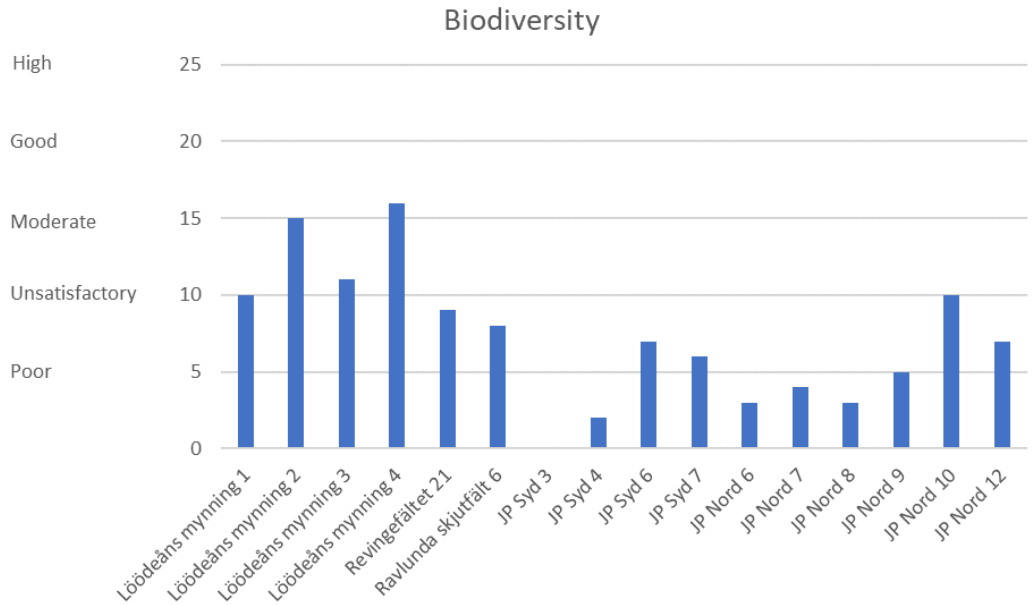
Biodiversity in wetlands - results

A total of 23 created or restored wetlands within the project were investigated in 2019. The wetlands were in Scania (four areas, figure 9) and in Denmark (one area, figure 10). Of these 23 wetlands, 7 had dried out or had almost dried out and were subsequently excluded from the survey. The results of the investigated wetlands show that only five out of 16 wetlands had at least a moderate physical potential for biodiversity (figure 11).

The biodiversity scores in the 16 investigated wetlands were only at least moderate in two of these. One, Jægerspris syd (JP Syd 3), was scored as failed biodiversity (figure 12).



Figur 11. Total scores for the physical potential for biodiversity in 16 investigated wetlands at Löddeåns mynning, Revingefältet and Ravlunda skjutfält in Scania, and at Jægerspris Skydeterræn in Denmark.



Figur 12. Total scores for biodiversity in 16 investigated wetland at Löddeåns mynning, Revingefältet and Ravlunda skjutfält in Scania and at Jægerspris Skydeterræn in Denmark.

A comparison of the physical potential for biodiversity and measured biodiversity in the 16 wetlands within SemiAquaticLife with 47 other wetlands in Scania reveal no significant differences between these two categories (figure 13). For the physical potential, the average scores are just below moderate whereas the biological scores are just below the cores for unsatisfactory (figure 13).

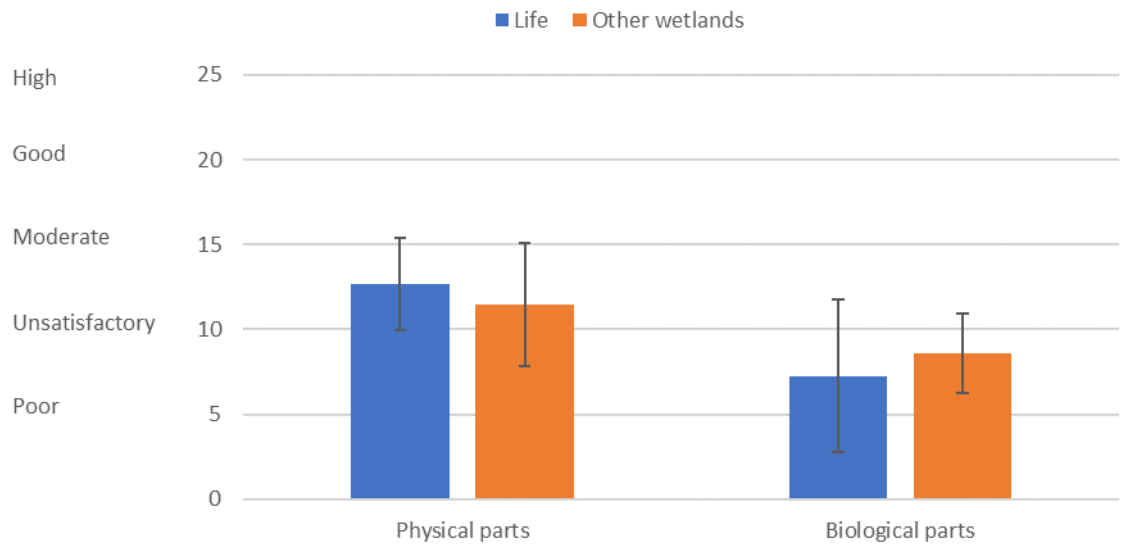


Figure 13. Mean scores (±1 Standard deviation) for the physical potential for biodiversity and for measured biodiversity in 16 wetlands created within SemiAquaticLife in comparison to 47 other wetlands created in Scania within The Rural Development Programme (data from Hassel, 2011 and Hertonsson et al., 2011).

There is no perfect scoring system, and the system we have used for scoring biodiversity also has some flaws. The method is reliable, and gives information about wetlands and their potential for biodiversity in a cost-efficient way, but the scoring system needs to be interpreted with caution. This is because it is simply not possible to get the highest score for a wetland because this would require both the presence of several fish species as well as high scores for e.g., amphibians. Most species of amphibians in SemiAquaticLife thrive in permanent wetlands without fish. Furthermore, some of the threatened amphibians within SemiAquaticLife (natterjack toad and green toad) thrive in small temporary wetlands and these have apart from amphibians a low biodiversity in general. For example, many of the wading birds are found only in larger wetlands. Furthermore, many of the investigated wetlands within SemiAquaticLife are newly created and it is likely that it takes several years for fauna and flora to colonise and develop in the wetlands. Nevertheless, it can be concluded that the wetlands created or restored within SemiAquaticLife have at least the same potential for and/or biodiversity as other created wetlands in Scania.

Relevant literature

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Ecosystem services in SemiAquatic Life

This report presents ecosystem services provided by the actions conducted within the Life project "SemiAquatic Life - Recreating habitat complexity for semi-aquatic fauna". The project has been running between 2016-2021 with the aim of restoring and improving the conservation status of amphibians, reptiles, and aquatic insects in Natura 2000 areas in southern Sweden (11 areas), Denmark (15 areas), and northern Germany (9 areas).

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