Creating green corridors under overhead lines

March 2023

Biological evolution: 10-years after report

Imprint

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Executive summary

The EU-funded LIFE Elia-RTE programme (2011-2017) took place mostly in Belgium under national transmission system operator (TSO), Elia's high voltage grid and partly in France beneath the infrastructure of the French TSO, *Réseau de Transport d'Electricité* (RTE). The goal of the project was to implement an alternative and integrated vegetation management system in forest corridors underneath power lines.

This report presents an analysis of 10 years of biological monitoring implemented on the restored sites, targeting a broad range of animal and plant species, in order to evaluate the outcome of the new management.

The data are analysed at three different scales: the entire site, the habitats, and the species.

The sites

The LIFE programme resulted in the implementation of new management techniques over about 500 ha. After the project concluded, it was succeeded by the Elia's 'Ecological corridor' strategy on 90% of the Belgian network (Act Now programme 2018-2022).

The success of the LIFE actions are evaluated in two ways:

- An "expert opinion" of how well the restoration actions worked and how beneficial they are for biodiversity
- A phytosociological description of grasslands before and/or after actions were implemented

Results:

- Success of the restoration actions in 70% (LIFE) and 29% (Ecological corridors, of which 35% are not yet evaluated) of the sites.
- Evidence of biological benefit in 82% of the sites (LIFE) and already in 24% of the Ecological corridors.
- The phytosociological description proved a clear increase of species number and diversity in most of the LIFE Elia-RTE sites included in this report (more details in section 3).

Habitats

The typology of habitats has been evaluated through a phytosociological survey over 136ha (67 sites), of which a total of 111ha are recognised as Natura 2000 habitat types. This report is the first update after the same method of identification was carried out at the end of the LIFE project in 2017. At that time, only 81ha were identified as Natura 2000 habitats, out of the overall surveyed area.

Some habitats form complexes of various EUR28[1] types, or they are not yet fully developed. This comprehensive survey also revealed that a more accurate mapping would be useful to further refine the results.

[1] The EUR28 typology of habitats follows the Interpretation Manual of European Union Habitats, a scientific reference document (https://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf).

Our evaluation shows that habitats listed in the EU Habitat Directive and restored in the forest corridors managed by Elia can contribute significantly to the Natura 2000 network. In fact, the Elia-managed habitats represent between 1-10% of the overall surface areas of their kind known in the biogeographic continental region.

Communities of species

The biodiversity in the forest corridors through which Elia's infrastructure runs is often high. The richness and the rarity of species observed emphasise the significant role that the electricity grid can play for nature conservation in Belgium, particularly in the context of the population movements induced by climate changes.

We observed:

- 111 species from the Walloon Red List of Threatened Species, for the 6 main monitored taxonomic groups
- 14 species targeted by Natura 2000: Annex II Habitat Directive or Annex I Bird Directive
- 8 different species of amphibians, 4 reptiles, 67 birds, 38 dragonflies, 16 bats
- A record on a single site of 151 plant and 43 butterfly species

1. Introduction

To ensure the safety of the electrical network, Transmission System Operators (TSO), such as Elia in Belgium, monitor the vegetation that grows in the immediate vicinity of the lines. Traditional vegetation management aims to continuously stop the natural growth of plants in order to secure overhead lines against interference from vegetation, which can cause short-circuits and outages. When high-voltage lines cross forest environments, the TSO manages the vegetation either by gyro-grinding or by manual cutting. Such complete and regular removal of vegetation in forest corridors regardless of the season is an inappropriate management of habitats and leads to various deleterious effects on biodiversity in concerned areas.

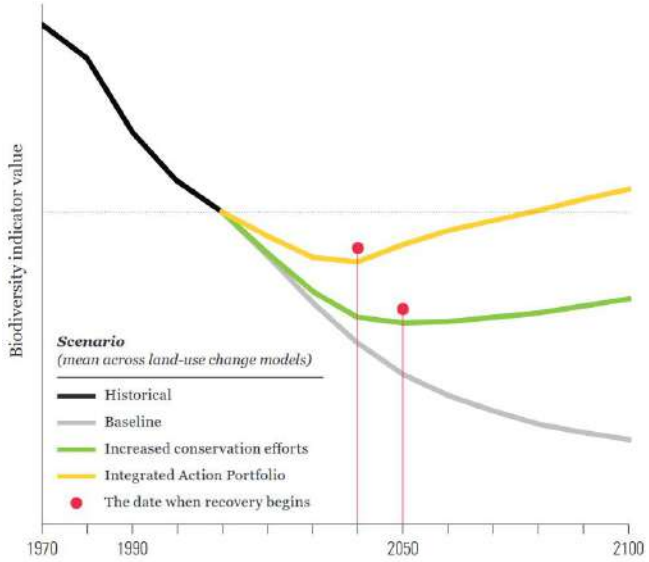
A first LIFE project (called LIFE Elia-RTE) took place in 2011-2017, mostly in Belgium under Elia's high voltage grid and partly in France beneath the infrastructure of the French TSO, *Réseau de Transport d'Electricité* (RTE). The goal of the project was to implement an alternative and integrated vegetation management system in forest corridors under power lines.
The benefits for biodiversity are identified as :

- Creation or restoration of new stable habitats such as grassland (meadow, pasture), forest edges, heathlands, orchards, and ponds by halting the endless cycle of heavy intervention (gyro-grinding) on vegetation regrowth, thus avoiding an 'ecological trap' problem.
- Replacement of management techniques causing direct destruction of some fragile species and natural habitats.
- Direct or indirect combatting of invasive alien plant species.
- Strengthening of the ecological network by improved connectivity for habitats and species between Natura 2000 sites/areas. This includes the benefit of creating stepping stones and extending Natura 2000 habitats outside the core sites along the linear infrastructure.
- Reduced forest fragmentation.
- Preservation of soil structure and integrity through conversion of forest corridor into stabilised vegetation.

Aside from the ecological issues, the new management system involving different stakeholders such as farmers, hunters, forest administration, and local authorities is a guarantee of durability (long term vision) and sustainability (reduction of the costs).

The LIFE Elia-RTE project was one of many projects supported by the LIFE programme of the European commission. Its overall budget of €3.2 million was funded as follows: 36% by the European Commission, 25% by the Walloon Region, 24% by Elia and 15% by RTE. This important contribution of public finances represents an extraordinary springboard for this private initiative of a long-term transformation of the vegetation management habits. These funds were a key prerequisite in initiating this change in practices.

At the end of the LIFE Elia-RTE project, Elia decided to continue the work undertaken during the LIFE and to broaden the new practices to other parts of the Belgian grid. This new project is now entitled “Ecological corridors” and is 100% funded by Elia as a part of its ambitious sustainability action plan “Act Now”, which itself includes strong components of environmental engagement. Elia’s aim is to achieve ecological management in 90% of its forest corridors within 2030. This is an ambitious and commendable initiative in the European landscape.



Graph 1.1. Evolution of the biodiversity expected with different management policies (Living Planet Report - WWF 2020). Elia’s sustainability action plan ”Act Now”, with the change of vegetation management it envisages for their right-of-ways, aims to be in line with the top yellow curve.

Ten years after the first concrete restoration actions began in Belgium, this report aims to give an overview of the evolution of the forest corridors in which ecological management was implemented, as well as of new areas where similar innovative management has been further developed.

Figures 1.1. Ecofirst has performed an uninterrupted biological monitoring for Elia under its high voltage power lines during the LIFE Elia-RTE project, as well as after its end. The aim is to evaluate habitat evolution and survey several taxonomic groups such as birds (Right), several orders of insects, plants (Left), etc.

2. Indices of site evolution

What happened within the “LIFE sites” and what is the outcome “ten-years after”?

In 2017, the LIFE Elia-RTE project ended with encouraging results, which significantly exceeded the initial goals, with about 138km (ca. 500ha) of the Belgian grid restored or planned for a future suitable management. Since most of the actions took place between 2012 and 2017, we expected to observe results to an extent related to the type of implementation measure taken: for example, that tree plantations in orchards and restored forest edges would respond much slower than newly created meadows or ponds.
Ten years after the story began, it is time to draw an overall picture of the biological monitoring commissioned by Elia to assess the successes… or indeed the failures, which can support the Ecological corridors strategy encompassed by the ‘Act Now’ programme.

Figure 2.1. Illustration of an ecologically managed forest security corridor (source: www.life-elia.eu)

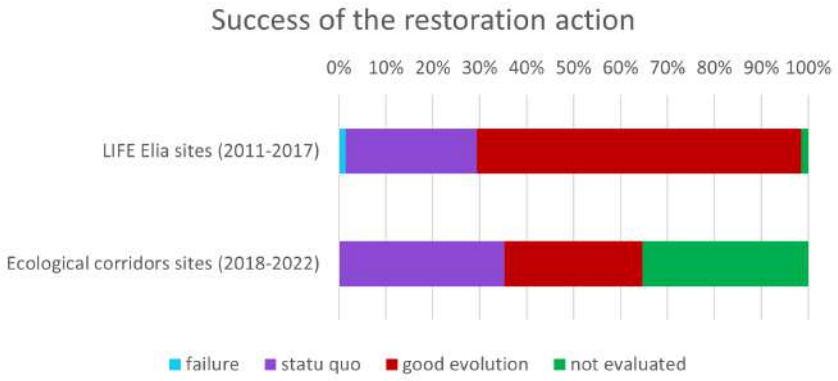
New habitats created or improved to host threatened biodiversity

The LIFE team imagined different solutions to combine a sustainable management of the forest security corridors by increasing low height vegetation associations such as grazed and mowed meadows, xerophilous grasslands, heathlands, or peat bogs. To achieve the conversion of the terrains, the initial restoration investment had to be followed by a suitable management by Elia and/or third parties, as defined in the management plans. One of the missions of Ecofirst since 2018 consisted in monitoring and, if necessary, adapting the management practices to meet the assigned goals.

In order to objectively characterise the evolution of the habitats over several hundreds of hectares, Ecofirst endeavoured to use its ecological expertise to evaluate the habitat quality by means of an approach which is both efficient and scientific. We combined the survey of different types of organisms and an overall description of the habitat structure, documented with georeferenced images.

Success of the restoration actions

On the basis of our expert opinion, we evaluate the success of restoration actions of LIFE sites as good in most of the cases (70%) whereas only one (small) site - out of a total of 68 sites - has clearly failed. The success of restoration was estimated by taking into account: (1) how well the goals of all LIFE actions that have been implemented within one site were achieved; and (2) if the ongoing management guarantees the future of these actions through e.g. long term commitments and contractualisation with third-parties, effectiveness of agro-environmental packages allocated to farmers etc.
Given that the newly managed sites of Elia'sEcological corridor strategy (2018-2022) are recently, if at all, restored, it is less relevant to evaluate these outcomes at present.However, the first findings are promising, with 5 sites - out of the 11 so far evaluated - already evolving in a good direction.



Graph 2.1. Evaluation of the success of the restoration actions on the sites

Success of the restoration actions

	failure	status quo	good evolution	not evaluated
LIFE Elia sites (2011-2017)	1	19	47	1
Ecological corridor sites (2018-2022)	0	6	5	6

Table 2.1. Evaluation of the success of the restoration action on the sites

Nearly all sites are located in the Walloon Region so far. Only two of them are located in Flanders, where the new management system has not yet been implemented. This reflects that most of the forest corridors were first selected in the more afforested part of Belgium (Wallonia) and that the Ecological corridor strategy is now being developed in the Flemish Region, where forests are more scarce.

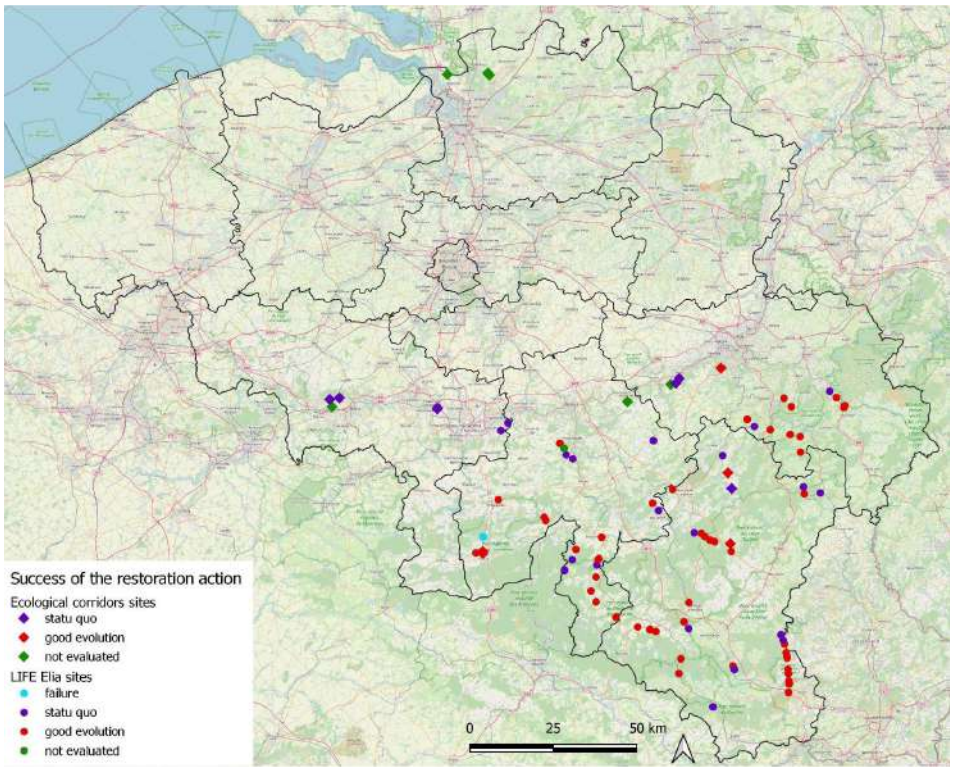
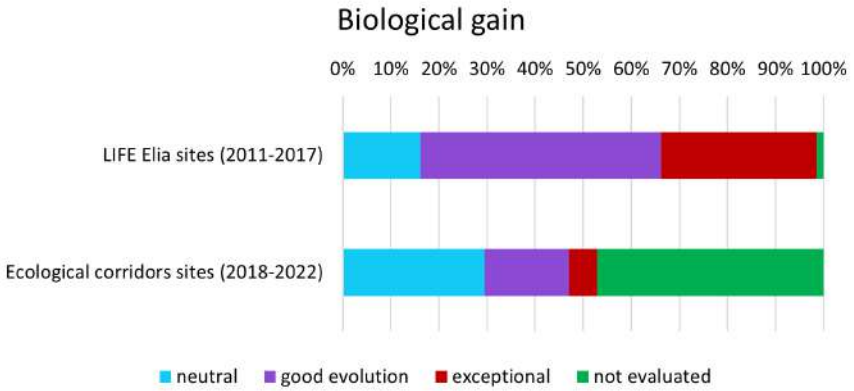


Figure 2.2. Evaluation of the success of the restoration action on the sites

Overall biological gain

Stating that a restoration/management action is successful does not automatically mean that a benefit for biodiversity is actually observed.

For this evaluation, we conducted sampling actions and observations of plants and selected animal taxa that are presented in sections 3 and 4. The results are summarised in table 2.2 and graph 2.2, showing that 82% of the sites are now in a better state in terms of biological quality than they were previously. Here again, it is too early to evaluate all Ecological corridors sites, although 4 sites out of 17 are evolving in a positive way.



Graph 2.2. Evaluation of the biological gain observed on the sites

Biological gain

	neutral	good evolution	exceptional	not evaluated
LIFE Elia sites (2011-2017)	11	34	22	1
Ecological corridors sites (2018-2022)	5	3	1	8*

Table 2.2. Evaluation of the biological gain observed on the sites (: note that 8 sites were not evaluated for 'biological gain' whereas only 6 were not evaluated for 'success of action' because not enough data were available for the former).*

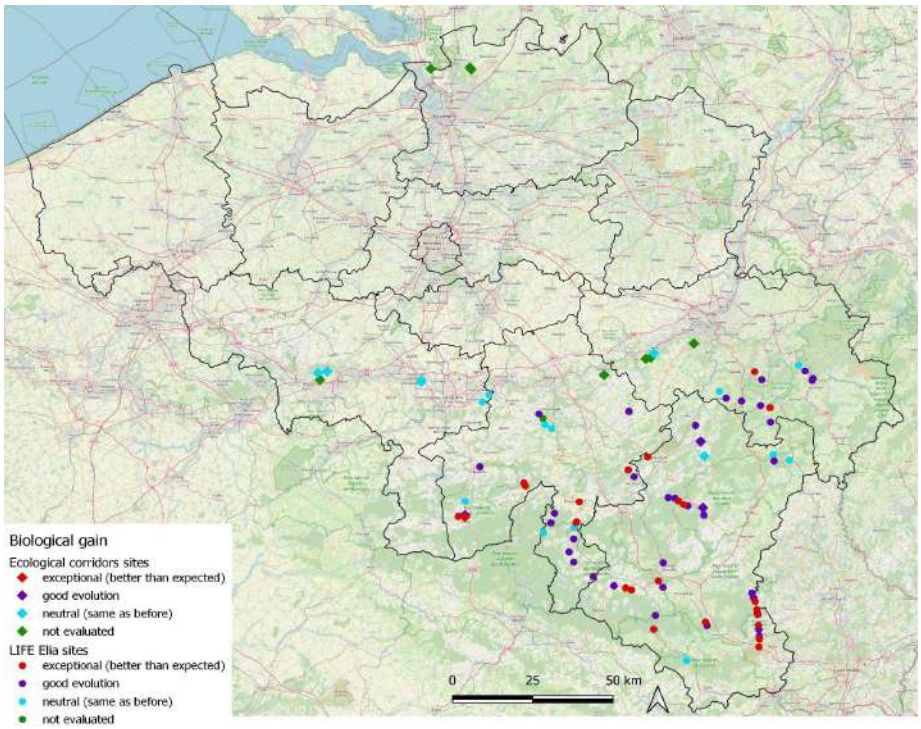


Figure 2.3. Evaluation of the biological gain observed on the sites

Measuring and comparing biodiversity indicators

Comparing sites with each other or comparing a single site over time is possible using indicators, i.e. a metric representing the richness or the diversity of species found. However, it is challenging to set up a method which does not involve a long term survey, based on repeated sampling of several taxa. Such a methodology quickly becomes difficult to organise when it comes to comparing several tens of sites scattered across a network of linear infrastructure. Additionally, the constraints encountered when the LIFE actions were planned (e.g. starting from scratch, lack of accurate mapping, negotiating with many stakeholders, coping with subcontractors' agenda etc.) decreased the possibility of systematically setting up a "before" monitoring with a holistic set of indicators.

Three scenarios are presented here, based on phytosociological description of the main habitats developing in the power line forest corridor. The method lists the plant species with an abundance index. This is the most common method of characterising habitat types in a comparable way between sites or to refer to vegetation associations described in the literature.

‘Before-after’ site restorations

Two diversity indicators are presented when measured before the LIFE restoration actions and after their implementation. To depict the existing habitats as comprehensively as possible , the vegetation has been described among several homogeneous subunits, which are analysed together.

Mellier (MELf)

LIFE actions: Mowed meadow (2.27ha) & grazed meadow (2.32ha)

The vegetation was initially described in 2015 on several areas chosen in the site of Mellier where it was planned to restore a grassland instead of the irregular mowing. The corridor then took the form of a grassy fallow land with an uneven structure and species composition.
After removing bushes and tree regrowth, a mix of seed (harvested in neighbouring meadows) was sown to restore a continuous meadow, which is mowed once per year. Note that the grazed pasture is not considered in the following analysis.

Before (2015)

After (2018 & 2022)

Mellier (mowed meadow)	**2015**	**2018 & 2022**	**Trend**
Number of species (S)	52	78	↗
Shannon diversity index (H)[2]	3.88	4.27	↗

[2]The Shannon diversity index is one of the most commonly used indices to measure the diversity of species in a community. Denoted as *H*, this index is calculated as:

$H = -\Sigma p_i * ln(p_i)$ where:

- **Σ:** A Greek symbol that means “sum”
- ***ln*:** Natural logarithm
- p_i**:** The proportion of the entire community made up of species *i*

The higher the value of *H*, the higher the diversity of species in a particular community. A value of *H* = 0 indicates a community that only has one species. The *ln* part of the expression weighs each species’ contribution to the value of *H*: additional species noticeably increase *H* value only if they are relatively common. In other words, communities dominated by few species (i.e. low diversity) obtain a low value of *H*.
(source: https://www.statology.org/shannon-diversity-index/)

The effect of creating a meadow, managed under appropriate practices (i.e. mowed once per year with hay collection), is easy to observe visually and was confirmed by the plant composition and diversity.

Bois d'Huqueny (HUQ)

LIFE actions: Mowed meadow, forest edge restoration (planting & selective cutting) & orchard

Initially, the forest corridor was narrow (~35m wide) and mainly colonised by eagle ferns (*Pteridium aquilinum*). After Elia widened the security distance by removing 7m of forest on both sides of the electrical line, the ferns were intensively managed by destroying their roots , after which a mix of seeds harvested in a neighbouring meadow was sown. The newly settled habitat now benefits from the increased light reaching the soil and is managed each year by mowing. The farmer harvests the hay, which is possible due to the development of vegetal diversity.
In addition, forest edges and a wild apple orchard were planted.

Before (2009)

After (2018 & 2019)

Bois d'Huqueny	2014	2018 & 2019	Trend
Number of species (S)	31	50	↗
Shannon diversity index (H)	3.35	3.86	↗

The initial species diversity was problematic to assess, since at least half of the area (~6.8ha) was covered by a dramatically low number of species (>90%covered by eagle fern), therefore it was decided to describe the vegetation where the diversity was the highest.
The evolution of the habitat is straightforward: more species and a higher diversity. At the scale of the site overall, the change is therefore huge. Since 2017, we are able to observe, year-on-year, a good evolution of the vegetation associations accompanied by the settlement of new precious populations of species.

Havelange (HAV)

LIFE actions: Forest edge restoration by planting, grassland mowing & ponds

Although the pictures are not taken exactly at the same place, one can see that the forest corridor was widened by Elia for the sake of security of the power line. The main LIFE action consisted in planting trees of an intermediate height, in order to create a forest edge. Between the bicycle trail and the forest, beneath the line, the vegetation is now managed by mowing, with the aim of decreasing the coverage of the eagle fern (*Pteridium aquilinum*).

Before (2014)

After (2021)

After promising first years of the recovery of a grassland, the observation made in 2021 is rather disappointing: the grassland has been partly damaged through the activities of the local forester(log removal; see picture below). Furthermore, the eagle fern seems to increase rapidly.

A better result would be achieved if the mowing could be realised under more strict regulations and the degradation of the soil strictly prohibited.

Havelange	2014	2021	Trend
Number of species (S)	37	38	~
Shannon diversity index (H)	3.53	3.54	~

The observed plant diversity and species richness did not change after the LIFE actions implementation, however the overall result is not negative because:

- The main action refers to the presence of the forest edges, which are currently growing;
- No input of external seeds was used, the natural process of restoration of the grassland (including the reduction of eagle fern) is logically slower than in other sites;
- The initial phytosociological description was performed after Elia's corridor widening, which allowed many pioneer species to settle in a freshly cleared ground along with tree regrowth. This artificially increased the number of species with many untypical ones.

After site restoration only

Because of aforementioned practical constraints, most of the sites could not be described in terms of plant species composition before LIFE actions were implemented. However, a huge database of georeferenced photos was set up. This weakness is largely compensated by an intense after-LIFE monitoring. Indeed, we targeted ca. 100ha of restoration action where an accurate phytosociological survey was carried out. This is a valuable follow-up, which provides evidence that LIFE actions were correctly planned and, above all, that the management is suitable and sustainable.

Fays-les-Veneurs Ouest (FLV-O)

LIFE actions: Mowed meadow, orchard & edge restoration

This stretch of forest corridor (FLV-O) is occupied by two power lines: a medium voltage line (Elia) and a low voltage line (managed by distribution system operator - DSO). A negotiated agreement with both operators resulted in a strong action to remove the dense coverage of eagle fern (*Pteridium aquilinum*) and restore forest edges through planting and selective cutting.
The ferns were first of all weakened over the course of two years (2013 and 2014) by a chemical-free method ("rolling"), after which a deep grinding of the roots was executed. We then sowed seeds (in 2015) on the bare soil to trigger a fast regrowth of grasses and annual species.
Together with the next forest corridor stretch (FLV-E), the new management plan covers a total area of 11.7ha (meadow & edges), of which meadows constitute 4.4ha.

Before (2013)

After (2022)

Fays-les-Veneurs (ouest)	**2021 & 2022**
Number of species (S)	58
Shannon diversity index (H)	3.95

It is not necessary to compare lists of plants to notice the good evolution of the habitat. The number of species, their diversity, and the rarity of some of them is highly satisfactory. Each year, new species of plants and arthropods are discovered and we advise further monitoring of the phytosociological composition of the developing habitats. It is worth emphasising that the meadows belong to targeted habitats of Natura 2000 network (namely 6230 and 6510 - the latter potentially evolving towards 6520). It is important to underline that in the closest Natura 2000 (BE34044 - Vallée du ruisseau des Aleines, 751ha, located 500-1000m away) the habitat 6520 is present (of which 12.6ha are mapped) but there is no habitat 6230 at all. Therefore, the restored meadows in the LIFE Elia-RTE site represent a significant increase of these habitats.

Rouge-Croix (RCX)

LIFE actions: Mowed meadow, digging ponds & edge restoration (planting)

The huge forest of Freyr, between Nassogne and Tenneville is crossed by a 9km long corridor where the first LIFE actions were planned. The microclimatic conditions are harsh on the plateau and the low pH of the soil creates favourable conditions for some of the most healthy peat bogs and peaty forests of the central Ardennes. In these circumstances, the forest growth is slow and the game fauna naturally maintains open glades. However, when the LIFE Elia-RTE started, the time had come for tree removal in order to maintain this. We took this opportunity to plan the restoration of diversified grasslands along with edge plantations and dig ponds. The area was mainly colonised in 2013 with a dense cover of *Molinia* grasses and eagle ferns (*Pteridium aquilinum*) and, locally, on the dampest ground, many relics of peat-associated plant species could be observed (*Vaccinium* and *Sphagnum* species, orchids, etc.). This section focusses on the grasslands restored on the dryer parts of the site after the last tree removal. A mix of local seeds was sown on the bare ground to speed up the colonisation of the grassland which would be subsequently mowed.

Before (May 2013)

Before (October 2013)

After (2021)

After (2021)

Rouge-Croix	2021 & 2022
Number of species (S)	70
Shannon diversity index (H)	4.15

After 9 years, a huge plant diversity is present, forming a complex mosaic of grasslands belonging to the 6230 *Nardus* associations together with 6510-6520 *Arrhenaterum* associations. In addition, on the wet, peaty parts of the area, many other typical plant species further increase the overall diversity. The "stabilisation" of the vegetation, in terms of security for the power line, is achieved by the annual mowing of the grassland.

Evolution without LIFE action
(i.e. LIFE site was described, no action necessary, site included in management plan)

In several cases, when the land was already managed in a good way to keep valuable habitats, no LIFE action had to be proposed. This happens when a landowner or a third-party involved found their own interest in keeping the forest corridor free of trees, for example hunters who maintain an open shooting line.
No LIFE action was implemented but, since a valuable habitat was recognised, a management plan was drafted along with a botanical description, in order at least to maintain the original biodiversity, and at best continue to improve the biological qualities of the site.

Anhée (ANH)

No LIFE action: Mowing by hunter before and still now

After: The calcareous grassland in 2022

Anhée	2014	2022	Trend
Number of species (S)	51	72	↗
Shannon diversity index (H)	3.86	4.22	↗

The thermophilous grassland, typical for limestone xeric habitat, observed in Anhée is very diversified. Both the number of species and the diversity index increased between the two surveys. This grassland, hosting many rare species, including orchids, is probably quite complex to describe thoroughly as it quickly evolves with cycles of shrub regrowth and their removal.

Take-home messages

LIFE Elia-RTE (2011-2017) resulted in a new management over ~500ha.

It was followed by the Ecological corridor strategy on 90% of the Belgian network (Act Now programme 2018-2022)

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The success of LIFE actions are evaluated in two ways:

- An "expert opinion" of how well the actions worked and how beneficial they are for biodiversity
- A phytosociological description of grasslands before and/or after actions were implemented

Results :

- **Success in 70%** (LIFE) and **29%** (Ecological corridors, of which 35% are not yet evaluated!) of the sites.
- **Evidence of biological benefit in 82% of the sites** (LIFE) **and already in 24%** of the Ecological corridors.
- The phytosociological description demonstrated **a clear increase of species number and diversity** in most of the LIFE Elia-RTE sites included in this report (more details in section 3).

3. Indices of habitat evolution

A thorough description of habitats to determine the outcome of restoration actions

In section 2 of this report, we analysed the outcome of the main LIFE and Ecological corridor actions in each geographically defined site (locality). Section 3 goes deeper into the analyses, since each mapped parcel (polygon) is considered. We digitised these parcels while actions and restorations were implemented and we wrote descriptor variables in the attribute table. Among these variables, a 'target action' was initially defined and needed to be updated by characterising the habitat types recognised during the biological monitoring surveys.

Method

Between 2018 and 2022, we performed biological monitoring of different types of organisms, including thorough phytosociological descriptions of selected habitats. The ponds are mainly still in the process of natural vegetation colonisation, therefore an accurate overall characterisation is not possible. Despite this, some rare species could be observed (see section 4). We analysed the relevés (unit of vegetation data collected) belonging to 67 vegetation units with statistical tools for an impartial classification of the vegetal associations and to determine which species can be used as indicator species.

A dataset of 4,709 phytosociological data was built out of an analysis of 6,144 pieces of plant data. The remaining 1,435 data pieces thus belong to unplanned observations worth considering together with faunistic data, when seeking rare or vulnerable species.

Steps:

1. The observations were organised in a database and associated with site cartography, to enable the correlation to be drawn between field observations and the LIFE actions mapped during the project.
2. The habitats of interest have been selected as the ones reacting fast enough to be able to observe a clear evolution within a period of 5 to 10 years. Only grasslands, heathland, and ponds are included in the following analysis, whereas edges and orchard plantations were kept for other future approaches.
3. We performed the analysis, including the following stages:
    a. Subdividing the dataset into groups objectively created (i.e. not based on our knowledge of the species autecology, nor their rarity or protection status). For this purpose, we used the *kMeans* algorithm[3], an unsupervised learning algorithm resulting in a non-hierarchical clustering of the dataset into 'k' groups. The algorithm categorises the items into k clusters of similarity. To calculate that similarity, the euclidean distance (distance

[3] The algorithm, defined by *kMeans* function of the R package *'stat'* works as follows (see for example https://www.geeksforgeeks.org/k-means-clustering-introduction/):

1. First, we randomly initialise k points, called 'means' or 'cluster centroids'.
2. We categorise each item to its closest mean and we update the mean's coordinates, which are the averages of the items categorised in that cluster so far.
3. We repeat the process for a given maximum number of iterations (here N = 10) and at the end, we have our clusters.

between two points) is used as measurement of similarity between sites based on the presence or absence of the species. We arbitrarily decided to form k = 10 clusters, since we expected that less than 10 main subtypes of vegetation associations could potentially be recognised. Trials with k = 5 were also tested, giving comparable results.

b. The *IndVal* algorithm was then executed (function *multipatt* from *indicspecies* R package), which aims to determine the species that explain the best the differences between the previously defined groups of sites, based on the presence or absence of the species in the relevés.

Results

The *kMeans* process defined 10 clusters fitting very well with the LIFE actions (table 3.1).

Sites_Actions	Group
BAMB_Prairie fauchée	1
BOUM_Prairie fauchée	1
COR-S_Prairie fleurie	1
CRU_Prairie fleurie	1
FLO_Prairie fleurie	1
HAV_Prairie fauchée	1
HEI-S_Prairie fleurie	1
LAN_Prairie fauchée	1
LAVA_Prairie fauchée	1
MAR-N_Prairie fauchée	1
MELf_Prairie fauchée	1
MELf_Prairie fleurie	1
MELp_Prairie pâturée	1
RIMER_Prairie pâturée	1
STN_Prairie fauchée	1
TEN_Prairie fauchée	1
BOUM_Prairie fleurie	4
FEL_Prairie fauchée	4
HUQ_Prairie fleurie	4
LIB_Prairie fauchée	4
LOU_Prairie fleurie	4
NOL_Prairie fleurie	4
BOV-CHI_Prairie fauchée	8
LANT_Prairie fauchée	8
POS_Prairie fleurie	8
SER-VEC_Prairie fauchée	8
SOY_Prairie fauchée	8
VON_Lande humide et mares	8
BABO_Prairie pâturée	9
BAI_Prairie fleurie	9
COR-N_Prairie fleurie	9
FLOsud_Prairie fleurie	9
FLV-E_Prairie fleurie	9
FLV-O_Prairie fleurie	9
HOU_Prairie fleurie	9
MAR-S_Prairie pâturée	9
RCX_Prairie fleurie	9
ANH_Pelouse calcicole	2
COU_Pelouse calcicole	2
COUP_Pelouse calcicole	2
DAI_Pelouse calcicole	2
OPP_Prairie fauchée	2
PON_Pelouse calcicole	2
BHE_Lande humide tourbeuse et mares	3
COCK_Lande à callune	3
EAU_Lande humide tourbeuse et mares	3
GRA-BI_Lande humide tourbeuse et mares	3
LAN_Lande humide tourbeuse et mares	3
RAH_Prairie pâturée	3
STO_Lande humide tourbeuse et mares	3
WAM_Lande à callune	3
AMC_Prairie pâturée	5
FRE_Lande humide et mares	5
POR_Prairie maigre	5
ROC_Prairie fauchée	6
AYE_Prairie maigre	7
AND_Prairie fauchée	10
CHE_Lande humide tourbeuse et mares	10
FLO_Lande humide tourbeuse et mares	10
HEI-S_Lande humide et mares	10
HUY_Prairie fauchée	10
MAZ_Prairie pâturée	10
PHI_Prairie fauchée	10
SER-VEC_Prairie fleurie	10
VERB_Lande humide tourbeuse et mares	10
VERB_Prairie fauchée	10
WIN_Lande à callune	10

Table 3.1. Full list of actions analysed in the sites where a phytosociological survey has been performed. The group number of the kMeans *clustering is provided to each unit (Sites_Actions).*

The interpretation of the groups formed is more or less straightforward. The groups 2, 3, and 5 gather, respectively, calcareous grasslands, heathlands on peat, and grasslands on peat. The groups 1, 4, 8 and 9 are composed of different types of grasslands, each group gathering more or less identified types of vegetation. For example, in the groups 4 and 9, we can find most of the mesophile highly diversified grasslands. The groups 6 and 7 are particular cases, each including only sites (ROC and AYE) where a very high diversity of habitats (thus also of species) is observed as a consequence of diverse substrate micro-conditions (pedological, geological, hygrometric). The group 10 is more difficult to interpret, since it gathers quite different types of habitats. The group should be understood as those sites not grouped otherwise, rather than as a coherent cluster.

We then analysed the groups of sites and the indicator species revealed by the *IndVal* process: 122 plant species were selected based on their statistical significance to differentiate the groups.

As a result, **we propose a typology of the vegetation on 111ha** (out of 136ha investigated) **for the first time since the LIFE Elia-RTE ended** (table 3.2). The EUR28 typology is a reference for European Union habitats that are described in the Interpretation Manual of European Union Habitats[4]. This codification is also used to designate habitats of community interest in the annex I of the Natura 2000 Habitat Directive.

Habitat EUR28	Area (ha)
6510	38.1
Not EUR28	24.4
6410	18
6230	14.0
6230 + 4010	11.1
6210	9.1
4030	4.8
6410 + 4010	4.7
4010	5.4
6230 + 6510	3.4
6230 + 4030	2.6
Sum	135.6

Table 3.2. List of the habitat typology defined on the basis of the biological monitoring (2018-2022). The table 3.3 provides details to better understand the meaning of each habitat code.

The values in table 3.2 are given for one habitat type or for a combination of two habitats. Indeed, some vegetation associations typically form complexes of 2 types of habitats that are found mixed together uniformly (mosaic) or when one progressively replaces the other along an edaphic (soil) gradient. We also frequently faced situations where the habitat is still evolving towards a final stable vegetation association that cannot be yet identified with certainty. Furthermore, some 6510 habitats might belong to the type 6520. The 6520 habitat is primarily characterised by altitudinal parameters and only secondarily by the presence of some rare plant species, forming in most cases in Belgium a complex of vegetation together with habitat 6510. However, we so far counted them only as 6510. Disentangling this question will be possible in the future, when the vegetation composition stabilises.

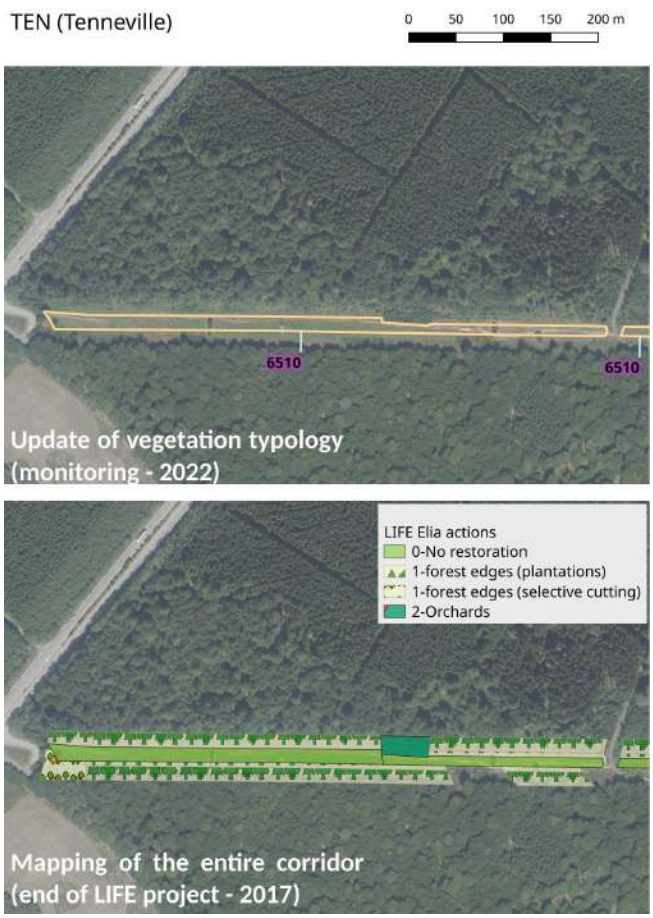
[4] http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf

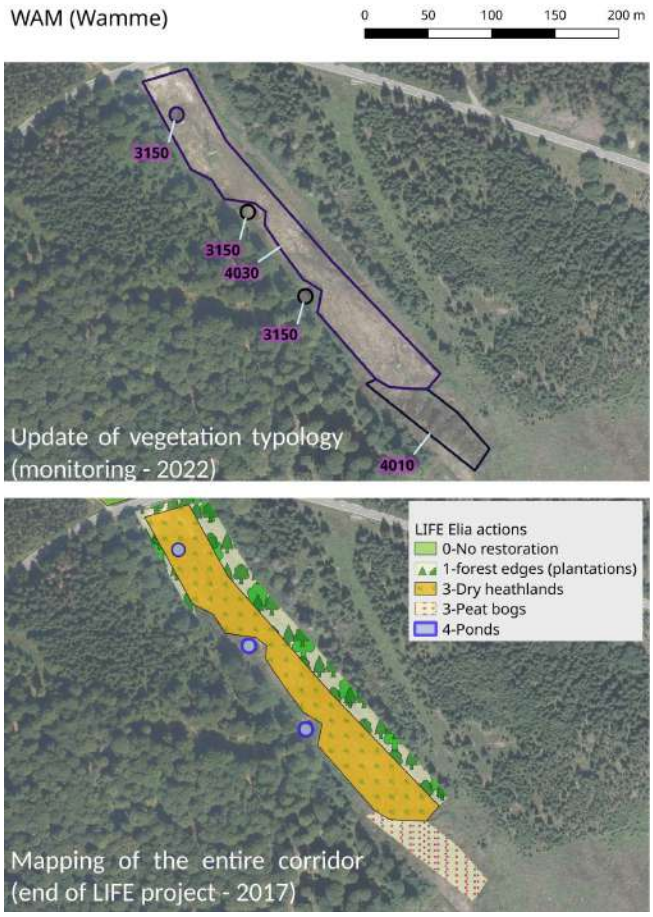
While of these EUR28 habitats were not present before the LIFE Elia-RTE project started, the restoration actions were always chosen in accordance with potentialities or fragments of existing habitats.

The EUR28 habitat types synthesised in table 3.2 are evaluated on the basis of the mapping as delivered at the end of the LIFE Elia-RTE project in 2017. This mapping was updated afterwards in terms of attribution only and did not account for shapes of the polygons. Some inaccuracies appeared when we visited the sites after a few years. The explanations for this are:

- The exact extent of actions often differs from what was planned (i.e. the part of edge plantations where trees did not survive and was finally mowed together with the central area);
- The difficulty of mapping forest corridors to a metric precision based on orthophoto maps;
- The complexity of mapping linear habitats, inherent to the structure of the power line network (for example, a shift of 1 metre along 1km of line results in 0.1ha of error!)

For these reasons, the numbers that are provided here should be taken as the first best estimates of the real surfaces. Some of them could decrease or increase if a more accurate mapping was accessible, at least on a selection of the most important sites. We provide two examples where one can see that (a) the identification of habitats represents only a part of the whole corridor area since no habitat typology was (yet) determined for edges or orchards and that (b) the accuracy of some polygons could be improved to obtain more accurate values of areas (figures 3.1 and 3.2).





Figures 3.1. (Left) and 3.2. (Right). In both cases, the upper map shows the habitat for which an EUR28 typology was assessed and, on the lower map, the complete mapping of the LIFE Elia-RTE actions delivered in 2017.

EU Habitat Directive Annex I - code	EU Habitat Directive Annex I - full name	Corresponding EUNIS habitat classification (between brackets: more precise codes when it could be determined)	URL link	EU conservation status (BE continental region)
4010	Northern Atlantic wet heaths with *Erica tetralix*	F4.1(1b)	https://eunis.eea.europa.eu/habitats/10082	Bad
4030	European dry heaths	F4.2	https://eunis.eea.europa.eu/habitats/10084	Bad
6210 (*priority habitat)	Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites)	E1.26	https://eunis.eea.europa.eu/habitats/10120	Bad
6230	Species-rich *Nardus* grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe)	E1.7(1)	https://eunis.eea.europa.eu/habitats/10122	Bad
6410	*Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)	E3.5(1)	https://eunis.eea.europa.eu/habitats/10131	Bad
6510	Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)	E2.2(2)	https://eunis.eea.europa.eu/habitats/10137	Bad
6520⁺	Mountain hay meadows	E2.3	https://eunis.eea.europa.eu/habitats/10138	Bad

Table 3.3. List of the heathland and grassland habitats listed in the 'EU Habitat Directive' and which were recognised among the monitored sites⁺: some 6510 habitats might belong to the 6520 type, at least as a complex of habitats.

4010 - Northern Atlantic wet heaths with Erica tetralix *(Amcômont, 2017)*

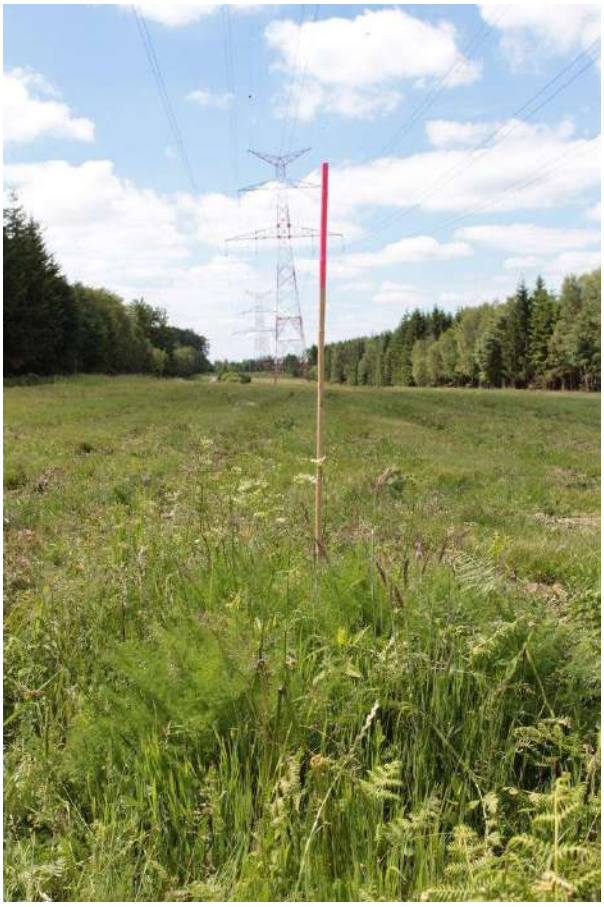
4030 - European dry heaths (Winenne, 2020)

6210 - Semi-natural dry grasslands and scrubland facies on calcareous substrates (Couvin, 2019)

6230 - Species-rich Nardus *grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe) (Corne du Bois - Attert, 2019)*

6410 - Molinia *meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) (Rochefort, 2016)*

*6510 - Lowland hay meadow (*Alopecurus pratensis, Sanguisorba officinalis*) (Nollevaux, 2021)*



6520 - Mountain hay meadows (Amcômont, 2017). Note: the characteristic plant of this habitat, Meum athamanticum*, is marked on the field with a stick, however the site was still classified in this report under 6510, since we cannot evaluate at present the exact extent of this habitat, which is most probably a mosaic of both 6510 and 6520.*

Figures 3.3. Examples of different EUR28 habitats present in the forest corridors under the Elia powerlines.

How did LIFE actions evolve into the current habitats?

One of the main goals of this report is to measure how the LIFE actions have successfully developed into habitats of great importance for biodiversity, as well as habitats targeted by the Natura 2000 Habitat Directive. To achieve this, we updated the original LIFE mapping of different action types with the actual habitat after analysing the recent monitoring data. Table 3.4 gives the detailed values among the 136ha described above, subdivided according to the LIFE action that led to it.

LIFE actions	4010	4030	6210	6230	6410	6510	6230 + 4010	6230 + 4030	6230 + 6510	6410 + 4010	No EUR28	Total
Mowed meadow			1.8		6.4	12.0				2.2	16.7	39.1
Meadow (sown)				6.7	2.2	22.8					1.9	33.6
Grazing				2.2	1.0	2.3	11.1	2.6	3.4		3.1	25.7
Mesophile grassland				5.1	2.9	1.0						9.0
Wet heathland and peat bog	4.9				1.5					2.6		9.0
Calcareous grassland			7.2									7.2
Swamp and wet heathland					4.0						2.7	6.7
Dry heathland	0.6	4.8										5.3
Total	5.4	4.8	9.1	14.0	18.0	38.1	11.1	2.6	3.4	4.7	24.4	**135.6**

Table 3.4. Cross table of the surfaces of initially planned LIFE actions (rows) and EU habitat types that are clearly recognised and/or towards which these areas evolve (columns).

The diversity of outcomes of one same action type is easy to notice on each row of the table, except in the very specific case of calcareous grasslands. In this case, we only adapted the management of a pre-existing grassland of this type.

The most interesting case is probably how the meadows (re)created after sowing seeds are evolving. Depending on the soil and the microclimatic conditions, the action resulted in 6510 hay meadows (22.8ha) but also in nearly 7ha of *Nardus* grasslands of the 6230 typology and more than 2ha of Molinion grasslands (6410).

The contribution of LIFE sites to Natura 2000 network

This report attempts to summarise 10 years of data collection for animal and plant populations and the habitats they live in. From the very first days, we understood that valuable biodiversity could be found in the forest corridors, at least temporarily, somehow playing a role which is comparable to that of forest glades. The restorations and management plans therefore aim to increase the stability of the habitats over the time, but also to act as a network which can increase the connectivity between open habitats.

On the following map (figure 3.4), the LIFE corridors are highlighted over the layer of forests to emphasise their interactions with the network of Natura 2000 sites. The EU Habitat Directive-targeted habitats which are created, developed, or simply properly managed within the Elia corridors can therefore be added to existing habitats of the same type inside Natura 2000 sites or outside them.

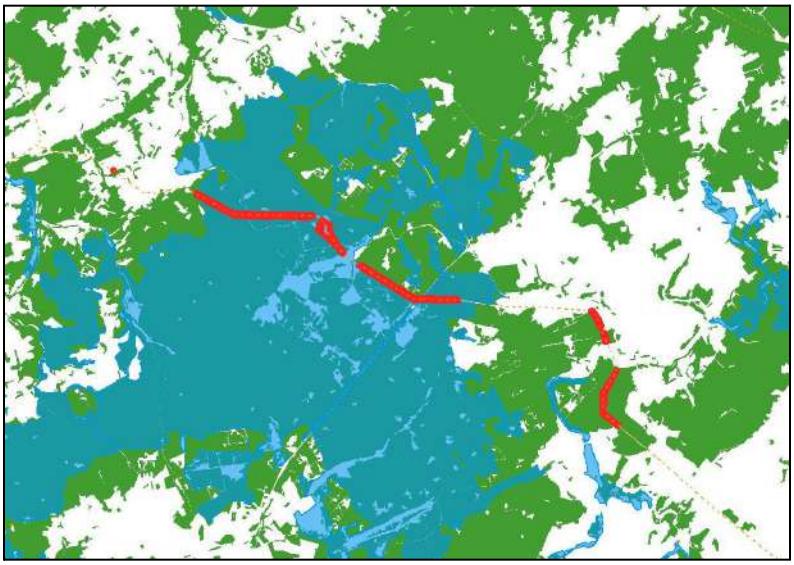
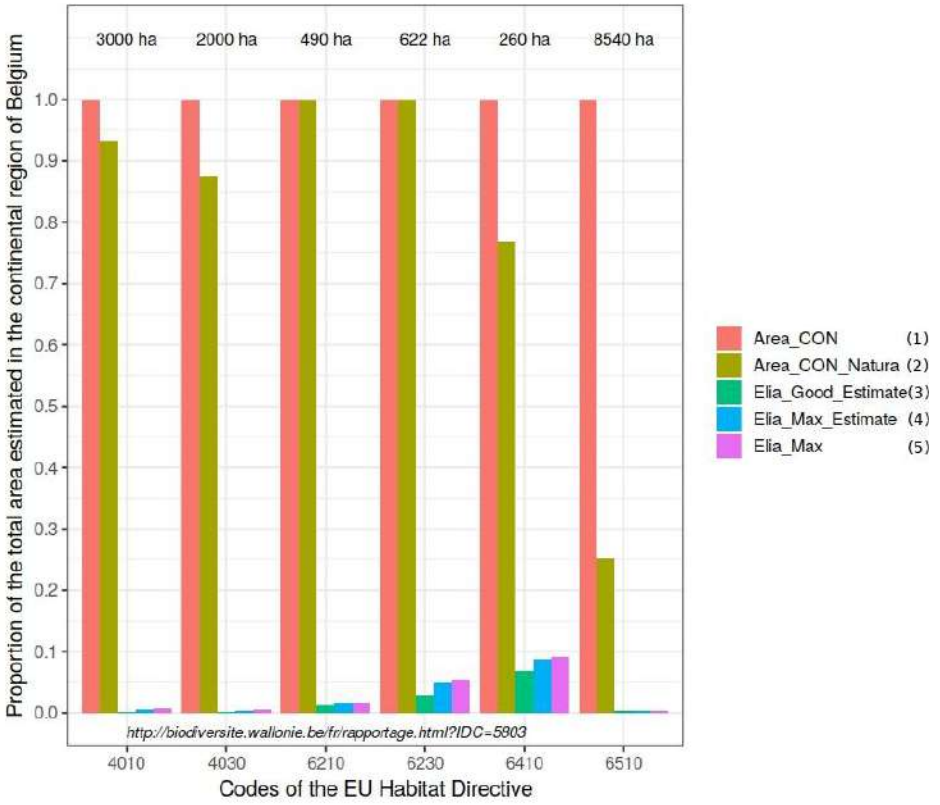


Figure 3.4. Sample of the power line network in the Ardennes, putting the emphasis on the interactions between forest corridors (red) with forest areas (green) and Natura 2000 sites (blue).

The actual and potential contributions to a network of habitats are shown on graph 3.1 and table 3.5. We can affirm that if **the habitats** identified earlier in this section continue to evolve favourably, **their contribution to the Natura 2000 network can range between 1-10** (0.2-12)**%,** depending on the habitat type considered. This order of magnitude **is valuable and even very significant** when one takes into account the reduced area of all forest corridors managed by Elia in Belgium.

Determining the exact metrics of these target habitats with greater accuracy therefore appears to be very important in order to place a value on the exact contribution of the past LIFE project and Act Now strategy to nature protection and halting the loss of biodiversity in Belgium. Areas' contribution could also be "converted" into ecosystem services (pollination, soil protection, increase of species populations) that Elia can emphasise these aspects in their overall activity report.

As exemplified on the figures 3.1 and 3.2, a better mapping of (complexes of) habitats and of the structure of the vegetation would be easy to adapt using the existing mapping as a base. Different technical solutions could be envisaged, including radio-calibrated high-precision GPS, drone, or LIDAR. Thus, Ecofirst will suggest an estimation of the number of sites and the techniques available, with a first consideration being made for drone imagery.



Graph 3.1. Proportions of EUR28 habitats identified within the Elia Ecological corridors in comparison with(1) the total area of these habitats known in Belgium (Area_CON = 1; surface areas in ha are shown above the bars), (2) the proportion of these surfaces which lie within Natura 2000 sites (Area_CON_Natura), (3) the proportion represented by the most conservative estimation of the habitats identified in this report (Elia_Good_Estimate), (4) the proportion represented by the highest estimation of the habitats identified in this report (Elia_Max_Estimate), (5) the proportion represented by the highest estimation of the habitats potentially found among all mapped sites (Elia_Max).

EUR28 habitats	Minimum area identified in Elia grid (ha)	Percentage of each habitat in Natura 2000 (minimum area)	Maximum area potentially assessed (ha)	Percentage of each habitat in Natura 2000 (maximum area)
4010	4.47	0.2 %	24.4	0.9 %
4030	4.78	0.3 %	10.1	0.6 %
6210	6.72	1.4 %	8.6	1.75 %
6230	**17.7**	**2.85 %**	**33.4**	**5.4 %**
6410	**18**	**9 %**	**23.7**	**11.85 %**
6510	30.8	1.4 %	37.6	1.75 %

Table 3.5. Range of the most conservative to the most optimistic proportion of the EUR28 habitats present in the Elia Ecological corridors in relation to the same habitats known from the Natura 2000 sites in the Belgian continental biogeographic region.

What about the other LIFE actions?

Ponds

Any permanent body of water in a forest environment is greatly appreciated by many types of organisms. Mammals (bats or larger non-flying ones), invertebrates (dragonflies), amphibians, and many specialised plant species were monitored over the last 5 years. We systematically took 3-4 photos of each pond we visited. Our main conclusion so far is that the vegetal colonisation occurs at different paces. In all cases, we identified the same group of dragonflies and newt species (see section 4) very early in the monitoring, however it seems that major changes in the faunistic composition might last several more years. The most striking success was the identification many crested newts (*Triturus cristatus*) in Doische in 2022. It can be concluded that this species has recently colonised the ponds, since it could not be observed during the first trapping campaigns organised during the LIFE project.

As was already reported in the project's final report (2018), high activity levels of bats hunting for flies have always been observed above the ponds, even those which were recently dug.

We did not check each one of the 170 ponds created during the LIFE project, but there are several cases known to us where the water is not persistent year-round or no longer present at all. The rate of success of this action lies most probably around95%. We performed a vegetation description at 39 ponds during the after-LIFE monitoring, however, the characterisation of the habitat typology is complicated, as it requires the measurement of conductivity. We assume that most of these ponds probably belong to the vegetation type 3150 - "Natural eutrophic lakes with Magnopotamion or Hydrocharition -type vegetation".

(Chevron, 2018 - LIFE Elia-RTE)

(Nassogne, 2022 - LIFE Elia-RTE)

(Rouge-Croix, 2022 - LIFE Elia-RTE)

(Courcelles, 2022 - Ecological corridors)

(Seraing, La Vecquée, 2022 - Ecological corridors)

(Bourseigne-Neuve, 2020 - LIFE Elia-RTE)

Figures 3.4. Some examples of the current appearance of the ponds within the grid corridors.

Forest edges

By the end of the LIFE project, we have created around 150ha of forest edges (94ha planted + 49ha restored by selective cutting), to which new edges will be progressively added within the scope of the Ecological corridor strategy. It is worth remembering that our experience showed various rates of success after rows of bushes and trees had been planted.

(Heinsch, 2016 - LIFE Elia-RTE)

Depending on the soil characteristics, the browsing pressure of game animals and the microclimatic conditions, we experienced results varying from a quick success (see Philippeville below) to a slow growth with good survival (see Florenville below), but also an almost total disappearance of the saplings. However, an accurate evaluation of the survival or growth has not yet been implemented.

(Philippeville, 2022 - LIFE Elia-RTE)

(Florenville, 2018 - LIFE Elia-RTE)

Figures 3.5. Some examples of the current appearance of the forest edges within the electrical corridors.

Orchards

Saplings of wild local fruit trees were planted across a total surface area of 12ha during the LIFE project. While the growth of trees is also dependent on external conditions, by simply documenting the sites with photos, the general conclusion is that wild apples, pears, and medlars are growing well. The individual tree protection equipment, added in a systematic manner, was certainly a decisive factor for the first years of growth. However, an accurate evaluation of the survival or growth has not yet been carried out.

(Hounscht, 2021 - LIFE Elia-RTE)

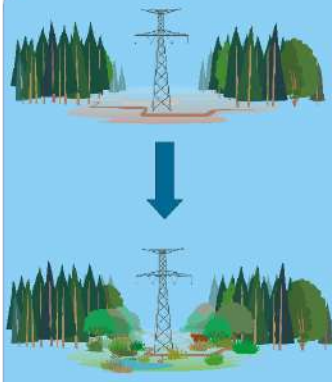
(Bois d'Huqueny, 2022 - LIFE Elia-RTE)

(Florenville, 2022 - LIFE Elia-RTE)

(Felenne, 2020 - LIFE Elia-RTE. Each branch sticking out of the tree guardis eaten by red deer Cervus elaphus*)*

Figures 3.6. Some examples of the appearance of the orchards within the electrical corridors (2020-2022).

Take-home messages



The typology of habitats managed or created within the scope of the LIFE Elia-RTE project has been evaluated through a phytosociological survey over **136ha (67 sites)**, of which a total of **111ha** are recognised as Natura 2000 habitat types. **This report is the first update** after the same method of identification was carried out at the end of the LIFE project in 2017 (when only 81ha were identified!).

–

Some habitats form complexes of various EUR28 types, or are not yet fully developed. This comprehensive survey also revealed that a more accurate mapping would be useful to further refine the results.

–

Our evaluation shows that habitats listed in the EU Habitat Directive and restored in the forest corridors managed by Elia can **contribute significantly to the Natura 2000 network**. In fact, the Elia-managed habitats represent a **proportion ranging from between 1-10 % of the overall surface areas** of their kind known in the continental biogeographic region.

4. Indices of the evolution of communities of species over time

How do Ecological corridors favour biodiversity ?

Aside from the creation of new habitats and the improvement of the conservation status of pre-existing habitats (see section 3), one of the main results of the LIFE Elia and Ecological corridors projects is the development of new habitats for species.

Some Ecological corridors act as stepping stones, allowing species to spread out from the core populations situated nearby, or providing a suitable habitat in which to 'stop over' during dispersion processes. This may contribute to connectivity between existing populations and reducing habitat fragmentation for some species. For instance, the ponds have proven to play this role, allowing amphibians and barred grass snake (*Natrix helvetica*) to expand their living range.

For other species, the development of a suitable habitat is allowing new populations to settle. This is especially the case with wildflower meadows, and grazing pastures, where a whole range of different vegetation patterns develops, depending on the soil (calcareous or more acidic) and the moisture (dry to wet), as described in section 3. These grassy areas are often very rich in flowers and host a huge biodiversity in insects (butterflies, grasshoppers, ladybirds to cite only the most studied ones), but also in birds, reptiles, etc. The Ecological corridors can serve as a breeding area, feeding zone, or even a rest stop for migrating species. For example, the wildflower meadows, heather moors, and orchards are particularly attractive for pollinators,while the black stork (*Ciconia nigra)* uses ponds to feed during their long migration journey.

Although Ecological corridors could sometimes be seen as scars through the forest and thus *suggest* forest fragmentation, on the contrary, such small size open environments in the forest are useful, if not essential, for many forest species. Bats and other mammals illustrate this special relationship, as some forest-dweling species forage in the corridors and others use the high voltage line to travel easily between hunting places and roost.

How is the evolution assessed ?

A "before-after" comparison can sometimes be possible at the level of the communities of species, but this is not always the case. In this case, some taxonomic groups were monitored in some sites both during and after the LIFE Elia-RTE project ("before" - 2011-2017; "after" - 2018-2022) . In particular, we assessed birds, butterflies, amphibians, and vascular plants with a quite similar methodology across a broad array of sites for the 2 periods. The monitoring undertaken during the LIFE project was either a survey before the change of vegetation (i.e. before the LIFE action was set up) or shortly thereafter (usually within the same year of the restoration action). This can be explained by a certain pragmatism and time optimisation, since in some cases, the restoration opportunity was decided too shortly before being implemented, so that it was simply not possible to establish a "before" monitoring in the appropriate time window. Furthermore, in some cases the situation before the restoration was so deleterious (e.g. 100% eagle fern) that a monitoring was not relevant. In addition, the amount of time

between “before” and “after” periods is not always the same. The monitoring of the ponds is a good example: since the ponds did not exist before we dug them, we assess the biodiversity evolution by comparing the early stage of development with a more mature and stabilised habitat, based on the observation of the amphibians and dragonflies populations, together with a botanical description.

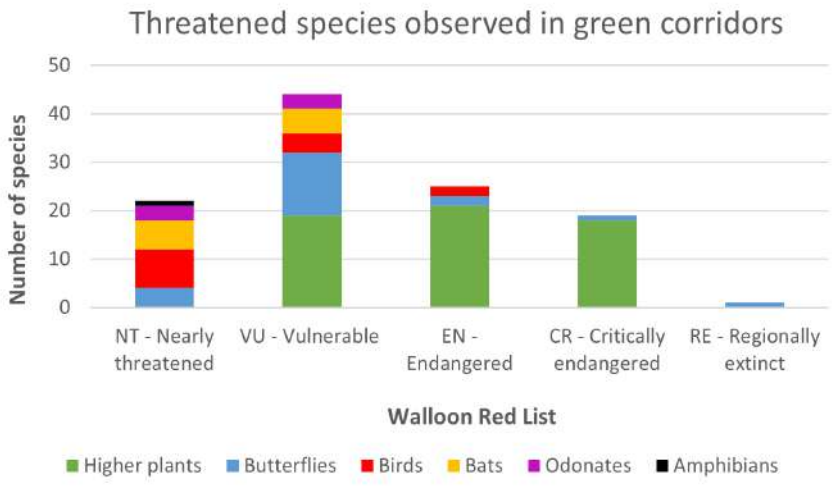
Some other taxonomic groups have only been observed and monitored since 2018, as a testimony of the habitat quality and its capacity to host interesting species populations. This is mainly the case with orthopterans (grasshoppers and bush crickets), bugs, ladybirds, reptiles, hazel dormouse *(Muscardinus avellanarius)*, etc.

Bats are an exception. In this case, we monitored their populations both during and after the LIFE Elia-RTE period, but the comparison is not really appropriate. This is because the methodology and technical equipment have evolved so much (e.g. ultrasonic detectors), that we cannot assume the equivalence (neither in quality nor in quantity) of the data collected.

Focus on rare, threatened, or interesting species

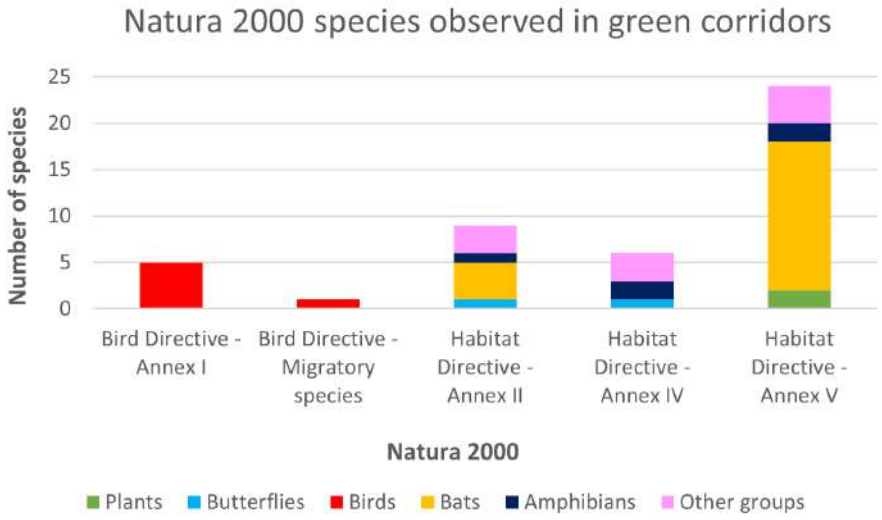
In an attempt to “measure” the biodiversity in the Elia natural sites, we can count the number of species present (which is sometimes relevant, sometimes not) and we can also examine the presence of rare and/or threatened species. For this latter task, we selected, among all species observed, the species that appear in the Red List of Threatened Species, evaluated at a Walloon level. The Red List is a critical indicator of the health of biodiversity. The status of each species can be calculated at different geographical scales, thanks to a set of criteria defined by the IUCN (International Union for Conservation of Nature). The Red List of Threatened Species is composed of all species with an unfavourable status: Nearly Threatened (NT), Vulnerable (VU), Endangered (EN), Critically Endangered (CR), Regionally extinct (RE). This means that common species (e.g. those with a Least Concern status - LC) or whose status cannot be evaluated, are not considered as part of the Red List. Here, we only took into consideration the main taxonomic groups we monitored, namely higher plants, butterflies, dragonflies, bats, birds, and amphibians.

Graph 4.1 illustrates the number of Red List species we have observed in the LIFE Elia-RTE and Ecological corridors sites since the beginning of the monitoring. Appendix 1 shows the exhaustive list of species and the number of sites where the species is present.



Graph 4.1. Number of species in the Walloon Red List observed in the LIFE Elia and Ecological corridors sites

Aside from the Red List status, another reference to define the rarity of a species are the Natura 2000 Directives (Habitat 92/43/EEC and Bird 2009/147/EC). Indeed, the Bird Directive aims to protect the wild bird species naturally occurring in the European Union. Its Annex I lists the species that are particularly threatened and for whose survival the designation of Natura 2000 sites is instrumental. The Bird Directive also states that Member States must ensure protection of other migratory bird species. The Habitat Directive ensures the conservation of a wide range of rare, threatened, or endemic (non-bird) animal and plant species. Annex II of the Habitat Directive lists the more endangered species at European level; core areas of their habitat are included in the Natura 2000 network and must be managed in accordance with the ecological needs of these species. Annex IV lists the species that require strict protection and, finally,Annex V lists the species which can be exploited or 'taken' in the wild, but must be monitored in order to maintain them in a favourable ecological status.
Graph 4.2 illustrates the number of Natura 2000 species we have observed in the LIFE Elia-RTE and Ecological corridors sites since the beginning of the monitoring in 2012. Appendix 1 shows the list of the species listed in Annex I of Bird Directive (BD - I) and Annex II of Habitat Directive (HD - II), with the number of sites where the species is present.



Graph 4.2. Number of species targeted by the Natura 2000 Directives observed in the LIFE Elia and Ecological corridors sites

For the 6 main taxonomic groups on which we focus here, we observed no less than 111 species from the Walloon Red List in the Ecological corridors. If we look at the species populations with a Natura 2000 approach, we can confirm the presence of 9 species listed in Annex II of the Habitat Directive and 5 species listed in Annex I of the Bird Directive. The presence of such rare and threatened species at a local or European level, is clear evidence of the richness of biodiversity that flourishes in these forest corridors. Of course, some of these species were already present before the LIFE project. Firstlly, we must recognise and celebrate the fact that the vegetation management undertaken by Elia and partners are keeping intact the biological richness that was already present in some parts of the electrical grid. But in most of the cases, this goes much, since lots of new rare species and interesting habitats have appeared or developed thanks to the new vegetation management practices or in the sites after restoration.

Short analysis of the communities of species by taxonomic group

Amphibians

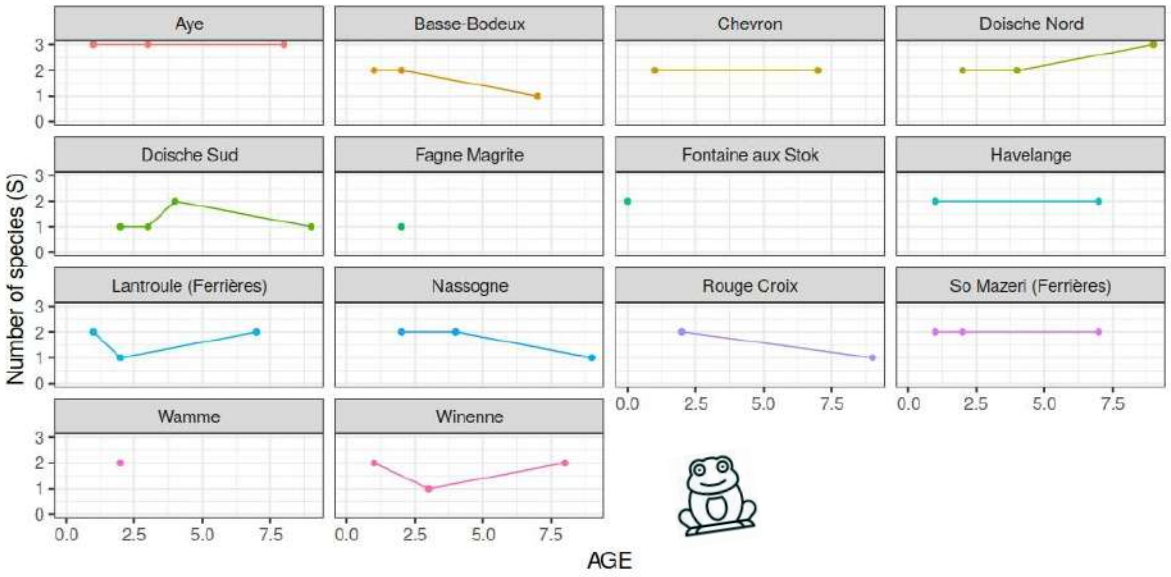
This class of organisms is a source of major concern at a global scale as well as in Europe. According to the IUCN *"More than half of all European amphibians (59%) and 42% of reptiles are in decline, which means that amphibians and reptiles are even more at risk than European mammals and birds."* (IUCN, 2022). The rate of degradation of wet and aquatic habitats and the dramatically rapid rate of development of specific diseases (e.g. chytridiomycosis) are responsible for a general decline of amphibians. Hence, creating new ponds in forests or elsewhere is crucial to help the populations to replenish.
As a result of the LIFE Elia-RTE project, 175 ponds were dug out. We monitored which species colonised the ponds and how fast, by means of live traps and additional observations across the sites. Up to 8 species could be observed, mainly newts which are easily caught in the traps (Table 4.1).

		2011	2012	2015	2016	2017	2019	2020	2021	2022
1	*Bufo bufo*	1					1	1	1	1
2	*Ichthyosaura alpestris*		1	16	8	15				18
3	*Lissotriton*									1
4	*Lissotriton helveticus*			21	10	12				27
5	*Lissotriton vulgaris*			3		2				3
6	*Pelophylax*			1	1	1	3	4		7
7	*Pelophylax ridibundus*									1
8	*Rana temporaria*	1	1	3	1	1	1		1	3
9	*Triturus cristatus*									4
		2	**2**	**5**	**4**	**5**	**3**	**2**	**2**	**8***

*Table 4.1. Number of amphibians recorded in the ponds each year. The grey columns mark the years when life traps were used. *Although 9 taxa are listed in 2022, the genus* Lissotriton *sp. is not counted in the number of species.*

Frogs and toads species are less prone to standardised sampling, but easily observed visually or acoustically. For this reason, the numbers do not reflect actual wild densities of the populations. However, thanks to our experience with identifying the calls, we can confidently assume that no other species were present in the monitored ponds.

The **fast natural colonisation of the newly created ponds** by amphibians is commonly observed, probably as a result of their seasonal migration. This was confirmed by our sampling, which started the first or second year after digging the ponds. In contrast, we generally did not observe additional species in the next few years, even when we repeated the sampling campaign 5 years on (in 2022).

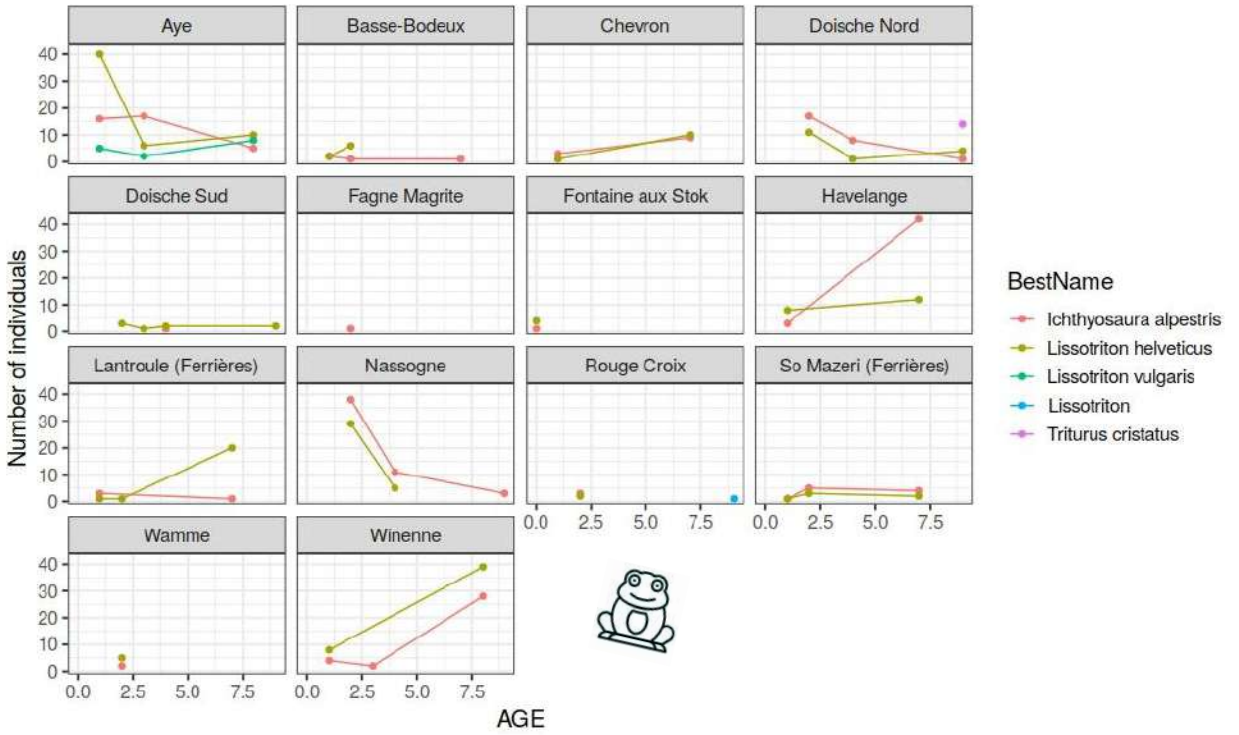


Graph 4.3. Evolution of the number of amphibian species recorded in the ponds over time in every monitored site (0 is the year the pond was dug)

In most of the cases, the two most common species of newts (*Lissotriton helveticus* and *Ichthyosaura alpestris*) were readily observed; sometimes tens of specimens were caught during one night (figures 4.1).

Figures 4.1. (Left picture) The males and females are quite different in newt species and as such are separately counted and photographed for each species. Here, we can see three Ichytosaura alpestris *(left) and one* Lissotriton helveticus *(right).*
(Right picture) Sometimes tens of specimens were caught during one night.

Only on one site (Aye), *Lissotriton vulgaris* was already observed during the first samplings. This species is less common than the other species observed. It should be emphasised that, on that site, ponds already existed before we created new ones.



Graph 4.4. Evolution of the number of specimens caught for each species of newt in the ponds over time (0 is the year the pond was dug).

The rarest of our 4 newt species, the **crested newt (*Triturus cristatus*)** is listed in Annex II of Natura 2000 Habitat Directive and considered as "NT - Nearly Threatened" in the Walloon Red List. This species has colonised a new string of ponds dug under the high tension line in Doische (Graph 4.4., top-right). These water bodies play both roles of reproductive sites and staging posts for the aquatic wildlife.

*Figures 4.2. A life trap is left, half-submerged, in a pond (left). The male of crested newt (*Triturus cristatus*) is very typical and easy to recognise (right)*

Reptiles

Reptiles can use the forest corridors as hunting areas, hibernating places, daytime resting places in summer, and dispersal pathways.

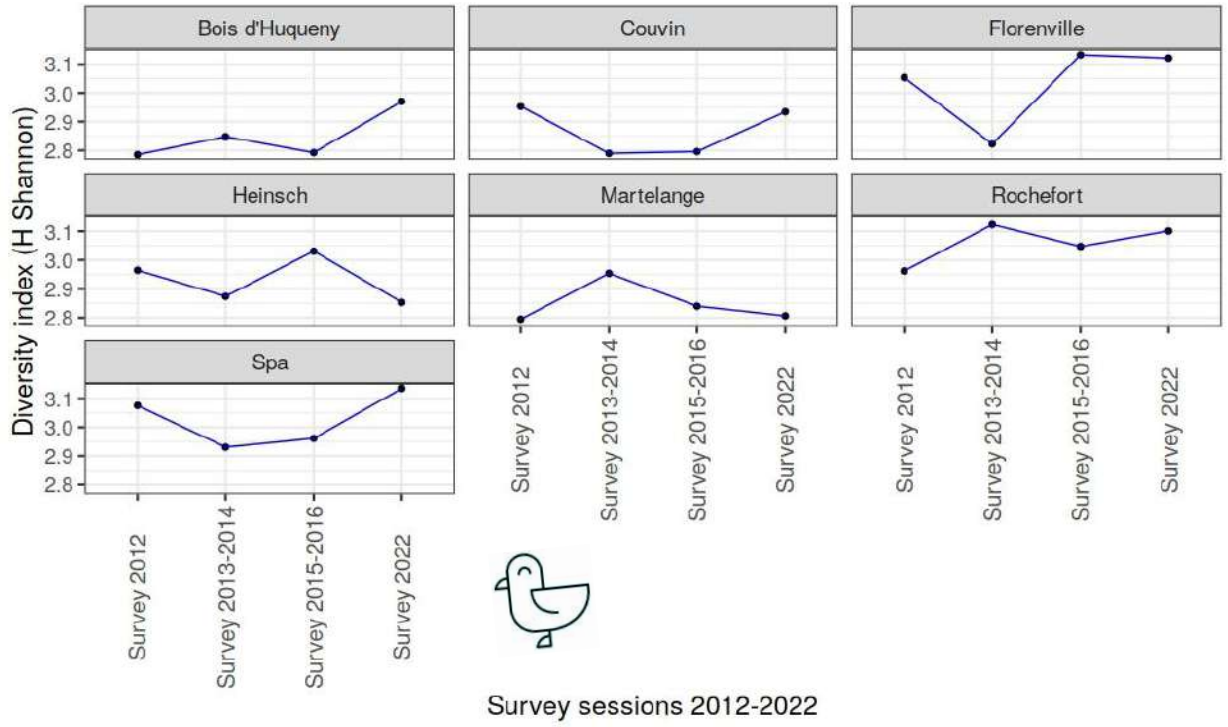
The **barred grass snake (*Natrix helvetica*)** is a good swimmer and hunts frogs, newts and small fishes in ponds, as observed in Winenne where a good population is well established. Another site hosting this species is the beautiful calcareous grassland of Couvin. Together with the **slow worm (*Anguis fragilis*)**, present in 12 sites and the **viviparous lizard (*Zootoca vivipara*)** observed in 26 sites, they can warm themselves in the hot microclimate provided by the reptile survey felts we installed in 7 suitable sites. The **common wall lizard (*Podarcis muralis*)**, assessed as Nearly Threatened in the Walloon Red List, frequents sunny, rocky environments and has been observed in Porallée.

*Figures 4.3. A barred grass snake (*Natrix helvetica*) discovered under a plate left on site for regular checking.*

Birds

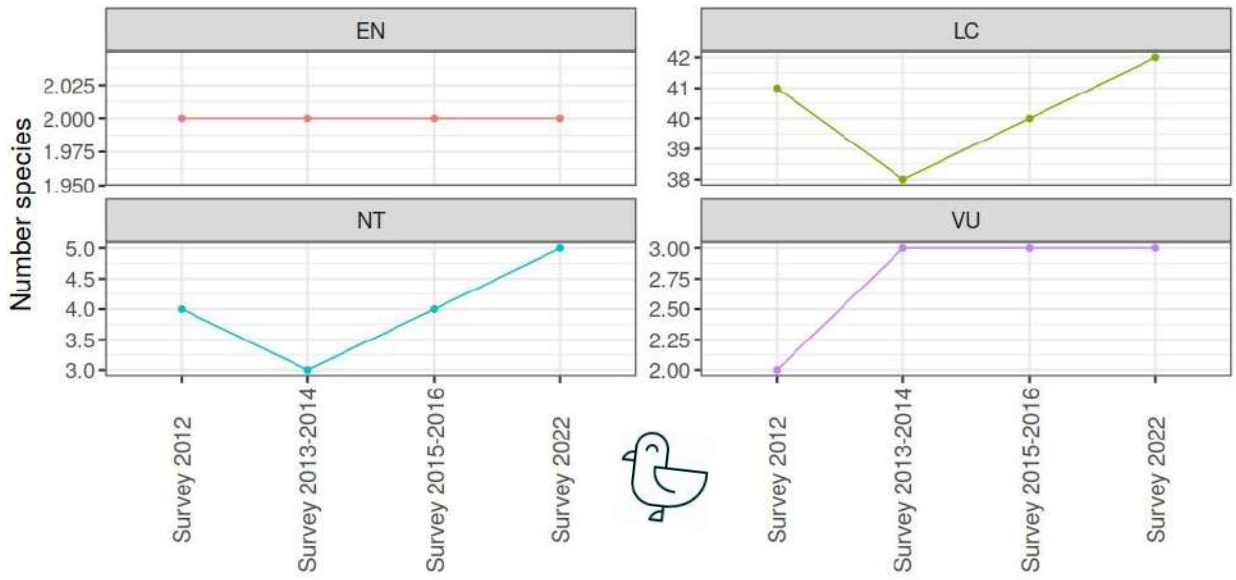
We studied birds through 4 inventory programmes between 2012 and 2022, using the bird 'point count' method. This technique consists in identifying and taking notes on all birds' behaviour (singing, courtship, simply hearing or seeing , etc.) from a fixed location over a period of 5 minutes. Two surveys are performed on a site in the same year during the spring: a first time ideally between March 30 - April 30,and a second time between 1st May - 20th June. Each site has several listening points and their number varies according to the size of the site.

In total, if we exclude migrating species which were observed stationary in the sites (non-breeding species at a local or even national stage), a total of 67 species have been observed. However, it's worth keeping in mind that, unlike the other taxonomic groups presented in this report, the birds spotted may be outside the forest corridor, since some bird songs or calls are audible at great distances. It's also important to notice that the analysis doesn't take into account the evolution of the forest areas parallel to the electrical line. The evolution of the diversity index (Graph 4.5) is contrasted, especially in the same site over time.



Graph 4.5. Evolution of the diversity index for each monitored site over time

Considering the Walloon Red List, one can see that the number of species is increasing over time (Vulnerable - VU, Nearly Threatened - NT and Least Concern - LC) or stable (Endangered - EN) (Graph 4.6).



Graph 4.6. Evolution of the number of species according to the status in the Walloon Red List

The 2 endangered species are the **common cuckoo (*Cuculus canorus*)** and the **European turtle dove (*Streptopelia turtur*)**, each found on 3 sites. They are not specifically linked to the forest corridors, but the transitions between open and close environments can suit them.

Three species are assessed as vulnerable : the **willow tit (*Poecile montanus*)**, the **redpoll (*Acanthis flammea*)** and the **willow warbler (*Phylloscopus trochilus*)**. The willow tit was observed in 3 sites with bushy wetland, the redpoll was only seen in Spa although forest is not its habitat. In contrast, the willow warbler was observed in 7 sites, throughout the entire monitoring period. This species seems to enjoy the shrubby stages in and close to power corridors.

Among the nearly threatened species, we can underline the **black stork (*Ciconia nigra*)** which rarely breeds close to Ecological corridors but comes to feed on the ponds dug during the LIFE project (inter alia in Doische and Tenneville) with a good ability to avoid electrical power lines in flight. Finally, despite the particular difficulty inevaluating the success of the creation of edges in the corridors on the breeding bird populations, we can state that at least locally, species like the **yellowhammer (*Emberiza citrinella* - NT)** and the **melodious warbler (*Hippolais polyglotta* - LC)** benefit from the mosaic of habitats under development.

Figures 4.4. The willow warbler (Phylloscopus trochilus), a vulnerable bird in Wallonia is frequently present in the electrical corridors - A black stork (Ciconia nigra) feeding in a pond dug by the LIFE Elia-RTE project

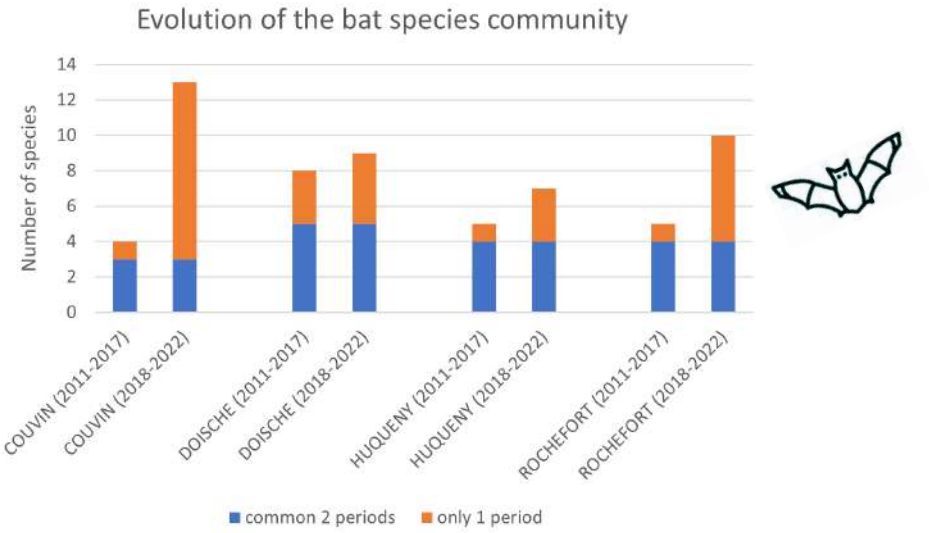
Mammals

Hazel dormouse (*Muscardinus avellanarius*): The shrub plantations and the selective cutting techniques applied in the forest edges in order to select the small or medium size trees or bushes (those which do not threaten to interfere with the power line) seem to offer a suitable habitat to hazel dormice, which have been observed in 7 forest corridors.

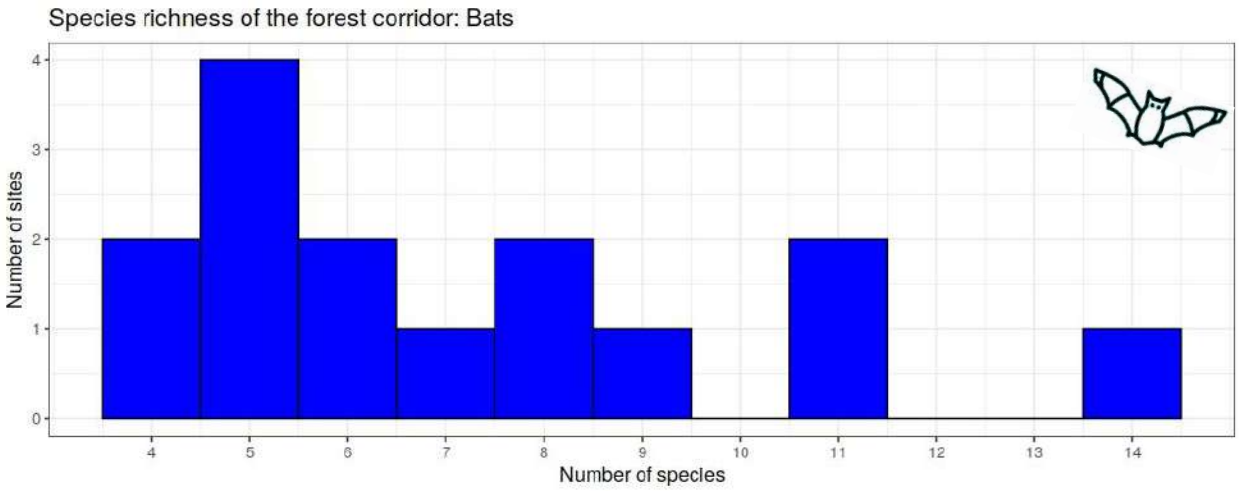
It is also worth mentioning the presence on 2 sites of **Eurasian beaver (*Castor fiber*)**, an Annex II Natura 2000 species, despite the fact that their presence is not related to the change of management practices. That is to say: they would be there anyway!

Bats: The bats exploiting the Ecological corridors are well represented in the threatened species list (11 species in the Walloon Red List), as well as the Natura 2000 species (4 Annex II species). A total of 16 different species (of the 24 species known in Belgium) have been heard on the different sites, with a maximum of 14 species in Couvin and 11 species in Rochefort. Even if the data collected with an active ultrasound detector during the LIFE period (2011-2017) cannot really be compared to the passive monitoring undertaken during the After-LIFE period (2018-2022), we can nevertheless observe in graph

4.7 a global positive evolution in the number of bat species detected in the sites assessed in both periods.



Graph 4.7. Evolution of the number of bat species detected on 4 sites where the monitoring allows a comparison



Graph 4.8. Communities of bats present in the LIFE Elia and Ecological corridors sites (N sites with bat monitoring = 15, N bats species in Belgium = 24).

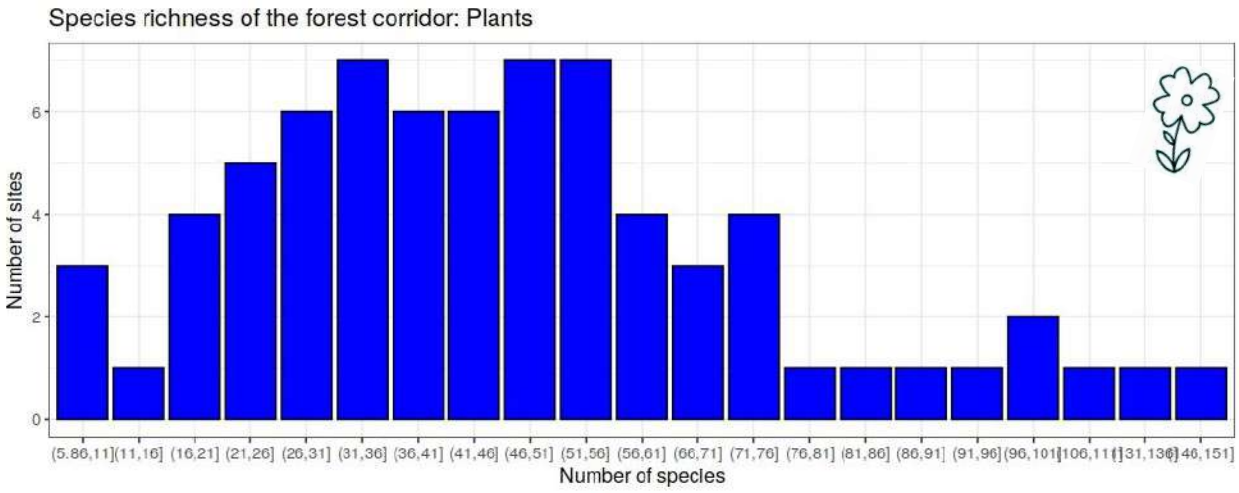
The rarest species at a regional scale are the 5 vulnerable species (VU on Walloon Red List) **noctule bat (*Nyctalus noctula*), grey long-eared bat (*Plecotus austriacus*), alcathoe whiskered bat (*Myotis alcathoe*), greater mouse-eared bat (*Myotis myotis*)** and **greater horseshoe bat (*Rhinolophus ferrumequinum*).** The last 2 are also listed in Annex II of the Habitat Directive and are a good example of species that take advantage of open areas in the immediate vicinity of the forest to look for prey (insects). They hunt beetles (ground beetles, coprophagous beetles) or grasshoppers at ground level (gleaning) and thus benefit from regular cutting (mowing) or grazing inside the corridor. *M. myotis* has been observed in 6 sites, *R. ferrumequinum* in 2 sites (Couvin and Nassogne). Two other annex II species Add to the Natura 2000 bat list: **geoffroy's bat (*Myotis emarginatus*)** in 4 sites and **bechstein's bat (*Myotis bechsteinii)*** in 2 sites. For completeness, it is worth mentioning 6 additional species which have a Nearly Threatened status (NT on Walloon Red List). Bats clearly use the forest corridors for several purposes. As aforementioned, some use them to forage, with various hunting strategies depending on the species

habits: aerial hawking (e.a. *Nyctalus* spp, *Eptesicus* spp) in or above the forest opening, gleaning on the ground or in the foliage of the forest edges (*Plecotus* spp or some *Myotis* species), or even exploiting the insect clouds that gather at sunset near the bushy edges or flowery orchards. Bats also use the straight openings in the forests as a daily flight route, thus these openings play a role in landscape connectivity, namely to travel between roosts and hunting areas. The typical slow echolocation rhythm and the short sequences recorded prove this behaviour of a rapid and direct flight. And finally, the forest edges could perhaps play a role during the swarming period by hosting singing males. Since our monitoring focused on the late spring / early summer period, we never collected information that could validate this hypothesis.


*Figures 4.5. (Left) The hazel dormouse (*Muscardinus avellanarius*) finds an interesting habitat in the new forest edges, thus the corridors contribute to their dispersal. (Right) The greater horseshoe bat (*Rhinolophus ferrumequinum*) benefits from grazed areas to hunt coprophagous insects.*

Plants

As described in section 3, we recorded an exceptional level of vegetation diversification in some sites after restoration actions or the change in management practices, with records of 151 species in Rochefort and 130 species in Aye. In some other sites, the vegetation remains more uniform.



Graph 4.9. Vegetation composition (number of plant species) in the LIFE Elia and Ecological corridors sites

A particular flora appeared over the years in numbers of ecological grassy corridors. The new management methods of these nutrient-poor meadows mostly consists of an extensive mowing with the harvest of hay. Several **orchid species** (such as ***Orchis simia*** in Oppagne, ***Epipactis purpurata*** in Bambësch, ***Ophrys fuciflora*** in Couvin, ***O. insectifera*** in Couvin and Dailly, ***O. apifera*** in Pondrôme, ***Orchis purpurea*** in Oppagne) have been able to use this opportunity to colonise these habitats. In dry conditions, the vegetation is often very diversified, including species on the Walloon Red List such as ***Ophioglossum vulgatum*** in Doische, ***Gentianella ciliata*** in Pondrôme, ***Orobanche caryophyllacea*** in Anhée, ***Dianthus armeria*** in Rochefort. Furthermore, ***Pedicularis sylvatica*** also appeared in a dozen sites and, the number of sites where this species appears is increasing from year to year in the dry and oligotrophic (nutrient-poor) habitats. ***Carex binervis*** finds a suitable habitat to develop in these grasslands, such as in Cockaifagne or Eau Rouge - Bois de la Hé.

One new stronghold of the vulnerable ***Lycopodium clavatum*** is present in Langlire, in a path along the corridor. The restoration action in this site consisted in soil-scraping, i.e. creating areas of bare soil in quite acidic conditions, which creates the new ideal habitat for the small *Lycopodium clavatum* to spread into the corridor.

Some rare species in the Walloon Red List are developing in the moorland and wet heathland which was restored beneath the power lines during the LIFE Elia-RTE project. For instance, we can cite ***Andromeda polifolia*** in Hockai-Grand Biseu, ***Lycopodiella inundata*** in Freylange, ***Narthecium ossifragum*** in Amcômont and Rouge-Eau - Nord, ***Vaccinium oxycoccos*** in Rouge-Croix, ***Cicendia filiformis*** in Porallée, ***Erica tetralix*** in 11 sites and several sites with beautiful populations of ***Sphagnum*** spp. ***Carex viridula*** is appearing in the bare soil zones that surround the ponds and has been observed in 11 sites.

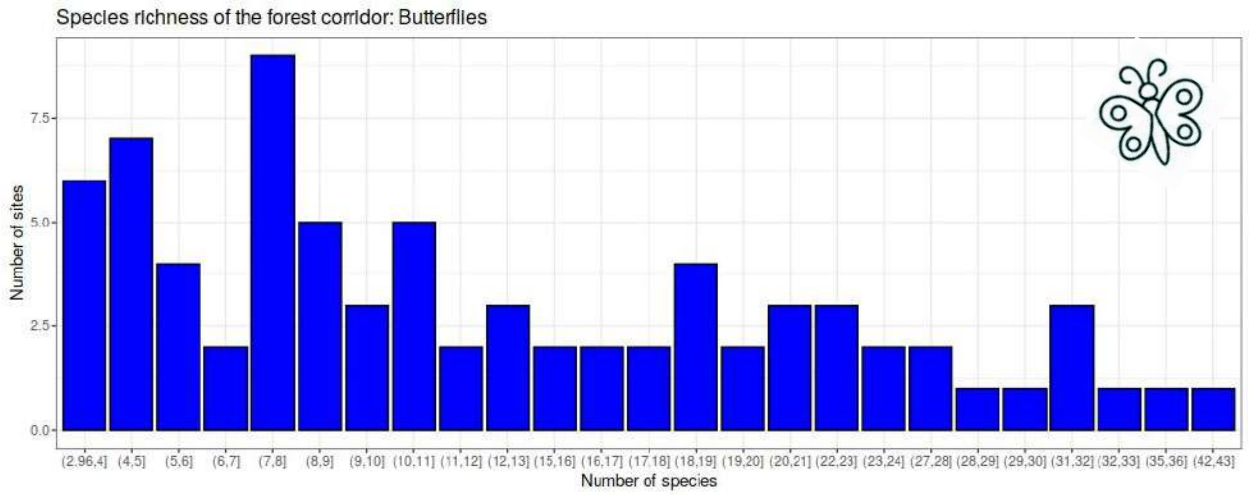
The critically endangered species ***Corynephorus canescens*** is present in some Ecological corridors sites in Flanders that have not yet been restored but show a good potential to become a xeric sand grassland.



Figures 4.5. (Left) Beautiful patches of Eriophorum angustifolium *are present in the forest corridor of Amcômont. (Centre)* Ophrys fuciflora *is developing in the calcareous grasslands of Couvin. (Right)* Orobanche caryophyllacea *is a rare parasitic plant that benefits from the regular mowing and hay harvesting.*

Butterflies

Flowers developing in meadows, but also in orchards and shrubs in forest edges, provide good nectar resources for adult butterflies to feed on. As the plant composition becomes richer, the period where butterflies can find everything they need in the corridors lengthens. In addition, lots of butterflies species can find the host plants needed for the caterpillars to grow directly within the forest opening, either in the herbaceous vegetation or in the woody fringe. We observed up to 43 species in Rochefort and 36 species in Doische.



Graph 4.10. Communities of butterflies present in the LIFE Elia and Ecological corridors sites (N butterfly species in Belgium = 120)

The **violet copper (*Lycaena helle*)** is the only Natura 2000 - Annex II butterfly observed in the forest corridors in Belgium. Within the beautiful swamp in Ottré, this species finds a suitable habitat with patches of its host plant (see pictures 4.7), the common bistort (*Bistorta officinalis*).

The **false heath fritillary (*Melitaea diamina*)** seems to like the moderately damp grassy electrical corridors. We hypothesise that it is seeking here its preferred host plants (Valerian *Valeriana spp*, Plantain *Plantago spp*, *Melampyrum spp*) that grow there thanks to the extensive vegetation management.

The rarest Walloon species observed is the **ilex hairstreak (*Satyrium ilicis*)**, critically endangered according tothe regional Red List. It likes the sunny edges of Doische and Winenne, where both flowers to feed and well exposed oaks to lay eggs are abundant.

The **scarce swallowtail (*Iphiclides podalirius*)** is a thermophilic species with a restricted range in Belgium. We observed it in Doische and Couvin. On this last site, we found it on a restored calcareous grassland, one of its preferred habitats in Belgium.

The observation of the migratory **long-tailed blue (*Lampides boeticus*)** in the site of Soy - Erezée is an additional evidence of the attractiveness of the habitats present in the electrical grid for species in transit. The warm, open, flowery areas can attract this butterfly in summer periods. The observation of this species is exceptional in Wallonia, since the main populations are from Southern Europe.

More frequent now, the **marbled fritillary (*Brenthis daphne*)**, which first appeared in Belgium in 2006, seems to enjoy the vegetation growing into the electrical corridors. We observed it on 43 sites. First

located in the southern part of the country, this species is now continuing its colonisation towards the north of the country, perhaps using the electrical corridors as dispersal routes.

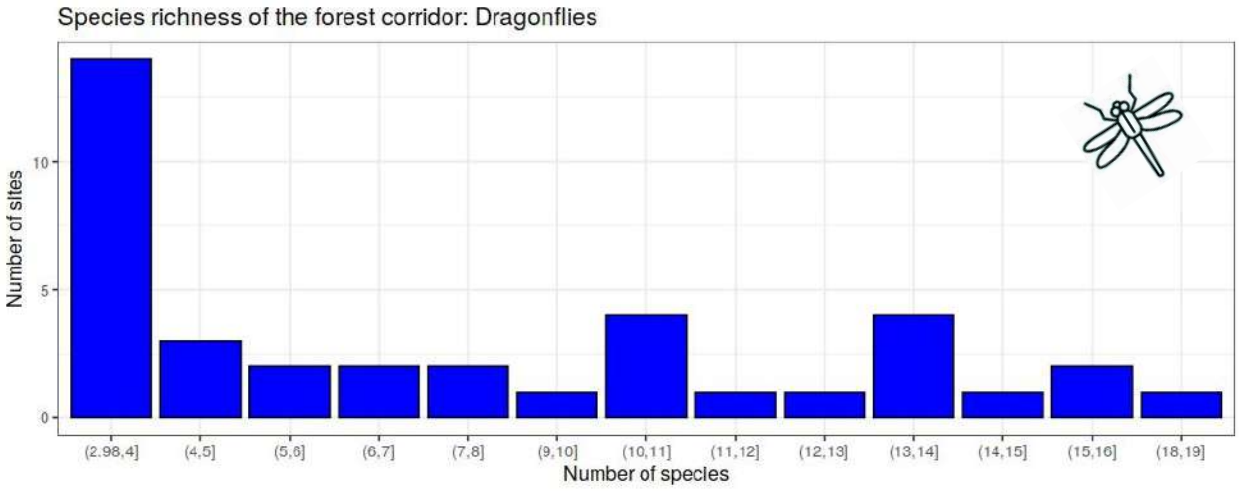
The rich flowery meadows begin to host several other Walloon Red List species only a few years after restoration, such as the **chalkhill blue (*Polyommatus coridon*)** in Pondrôme; the **dark green fritillary (*Argynnis aglaja*)** found in Florenville, Rochefort, Doische and Oppagne; and the **short-tailed blue (*Cupido argiades*)**, that was considered as regionally extinct until it reappeared in 2008, and which is already present in 4 LIFE Elia sites in the south of Wallonia (e.g. Post, Florenville). Other rare species like the **violet fritillary (*Boloria dia*)** appreciate clearings inside forest environments and bushy meadows, such as those found in Couvin, Doische and Pondrôme. The moorlands and wet heathlands such as Amcômont also host some very specialised species like the **cranberry fritillary (*Boloria aquilonaris*).**

*Figures 4.7. The caterpillars of the violet copper (*Lycaena helle*) (Centre-top) live and feed on common bistort in the corridor of Ottré (Left). An interesting diversity of butterflies is found in the Elia grid such as scarce swallowtail (*Iphiclides podalirius*) (Centre-down), violet fritillary (*Boloria dia*) (Right-top), long-tailed blue (*Lampides boeticus*) (Right-centre) and chalkhill blue (*Polyommatus coridon*) (Right-down)*

Dragonflies

When ponds are present on a site, we usually monitor dragonflies as an indicator of biodiversity richness, since their larvae develop in the stagnant water. As adults, some dragonfly species stay near their native ponds, while others hunt in the neighbourhood and some travel far away, but sooner or later, they come back to water to mate and lay eggs. In total, 38 different species have been observed in the Elia sites, with a maximum of 19 species in Doische Sud. We must take these numbers with caution because the monitoring was usually based on a single survey. Since the period in the year of presence measured differs between dragonfly species, an only date of monitoring means that we can only catch a glimpse of

the whole community, but this is still a pragmatic and efficient way of surveying which nevertheless brings good information.



Graph 4.11. Communities of dragonflies present in the LIFE Elia and Ecological corridors sites (N dragonfly species in Belgium = 69)

The two beautiful damselflies with metallic reflection ranked as vulnerable on the Walloon Red List, the **emerald spreadwing (*Lestes dryas*)** and **small spreadwing (*Lestes virens*) were found in** Langlire and Bambësch and in Freylange respectively. The latter was - until recently - thought extinct in Wallonia, but seems to have recovered territory and is now in expansion in Belgium. It likes the sunlit ponds with well-developed riparian vegetation, like those of Freylange.

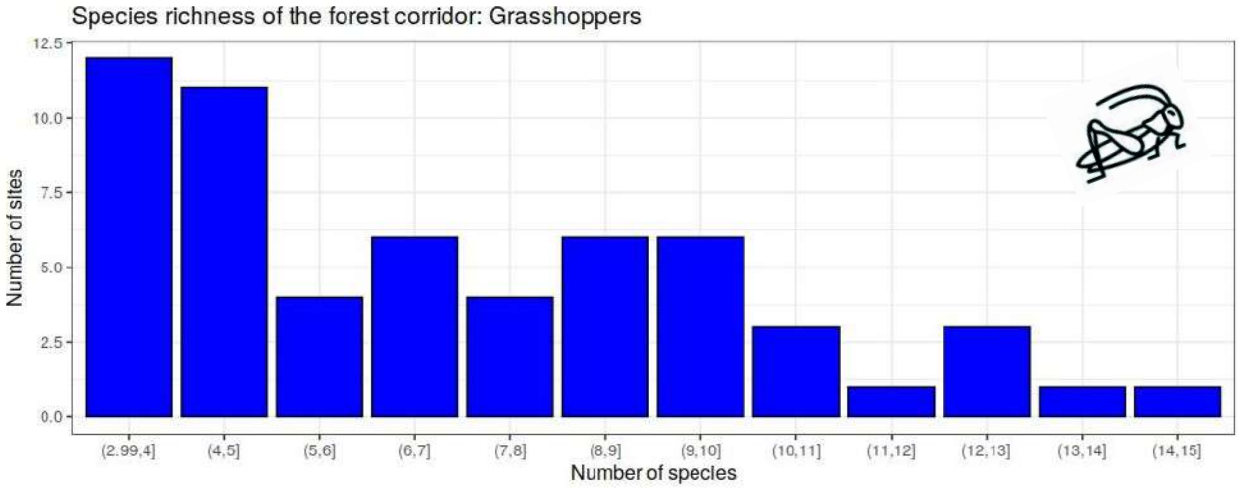
In the peat bogs open water live very specific and rare odonate species like the vulnerable **vagrant darter (*Sympetrum vulgatum*),** which was found in Nassogne. At this location, six ponds have been dug during the LIFE project, in addition to the dozens of other ponds created along approximately 10km of forest corridor, in a moorland landscape. The **white-faced darter (*Leucorrhinia dubia*)** and the **common hawker (*Aeshna juncea*)** also reproduce in these acidic ponds.

The **common clubtail (*Gomphus vulgatissimus*)** is found near the ponds of Winenne, despite its ecology being usually more linked to streams. Its distribution map is very piecemeal and the power grid can be a good support to guarantee the survival of this species in Wallonia.

Figures 4.8. (Left) Sympetrum fonscolombii *thrives on the hot and shallow ponds with scarce riparian vegetation. It has been observed in Baudour. (Right)* Orthetrum cancellatum *is a typical pioneer species, found on young ponds*

Grasshoppers

Orthopterans can be observed in a wide variety of environments, and most species have specific ecological requirements that make them interesting biological indicators. The communities of species vary with the vegetation composition and structure, with the soil moisture and the management practices. This is why we started to monitor this taxonomic group as a marker of the habitat evolution in the corridors.



Graph 4.12. Communities of grasshoppers present in the LIFE Elia and Ecological corridors sites (N grasshopper species in Belgium = 56)

First recorded in Belgium in 2019, we found the **italian locust (*Calliptamus italicus*)** at "Corne du Bois" (Attert) in 2020, where it occupies short grassy areas. Native to southern regions, the colonisation of this species of more northerly sites is probably explained by climatic changes. The **slender blue-winged grasshopper (*Sphingonotus caerulans*)** is another species living on dry areas with sparse vegetation. It was found in Rochefort in 2018.

The **field cricket** (***Gryllus campestris***), observed in 3 sites (Fays-les-Veneurs, Florenville and Bois d'Huqueny) is a very good indicator of nutrient-poor grasslands. The male digs a small burrow to attract females by chirping. Hence, the soil must remain undisturbed and not be supplied with fertiliser to keep a sparse and short vegetation cover. It *"requires quite large habitats or a functioning habitat network* [therefore] *small isolated areas are mostly vacant in contrast to many other species"*[5]. In Elia Ecological corridors, the conversion of these 3 sites (7.5ha altogether), from dense cover of eagle fern into yearly-mown nutrient-poor grasslands is most probably beneficial for the increase of the population of the field cricket. Furthermore, the same habitat restoration actions have been carried out on several other sites (8.3 ha in Nolleveaux, Baillamont, Louette, Les Cruserelles, Houdremont, Patignies), where it would be worth carrying out surveys to search for this species in the future.

The site "Corne du Bois" in Attert, where we restored diversified grasslands with the LIFE Elia-RTE project, is a real hot spot for grasshoppers. We found two rare species in Wallonia: the **steppe grasshopper**

[5] http://www.pyrgus.de/Gryllus_campestris_en.html

(*Chorthippus dorsatus*) and the **lesser marsh grasshopper (*Chorthippus albomarginatus*)**. The latter was also found in Heinsch, a few kilometres further south.

The **stripe-winged grasshopper (*Stenobothrus lineatus*)**, a highly-specific species to the xeric and calcareous grasslands, was found in the corridor in good conservation status in Anhée. Together with the highly diversified vegetation composition and the rare butterfly species, this grasshopper's presence is an additional testimony of the great interest of this site.

Another noteworthy observation is the **water-meadow grasshopper (*Pseudochorthippus montanus*)** in Spa (la Vecquée). This rare species lives mostly in the marshy meadows and the developing peat bogs and its occurrence in Wallonia is very scarce. Offering to this species a suitable habitat in the electrical grid is a valuable contribution to its conservation.

*Figures 4.9. (Top-left) The italian locust (*Calliptamus italicus*) is a southern species, spreading with climatic changes, that found good conditions to stop in a corridor in Attert. (Top-right) The field cricket (*Gryllus campestris*) is established on the new nutrient-poor meadows, which confirms the success of the habitat restoration. (Left-down) The stripe-winged grasshopper (*Stenobothrus lineatus*) gives a hint of the high quality of the habitat.*

Other interesting animals in other taxonomic groups

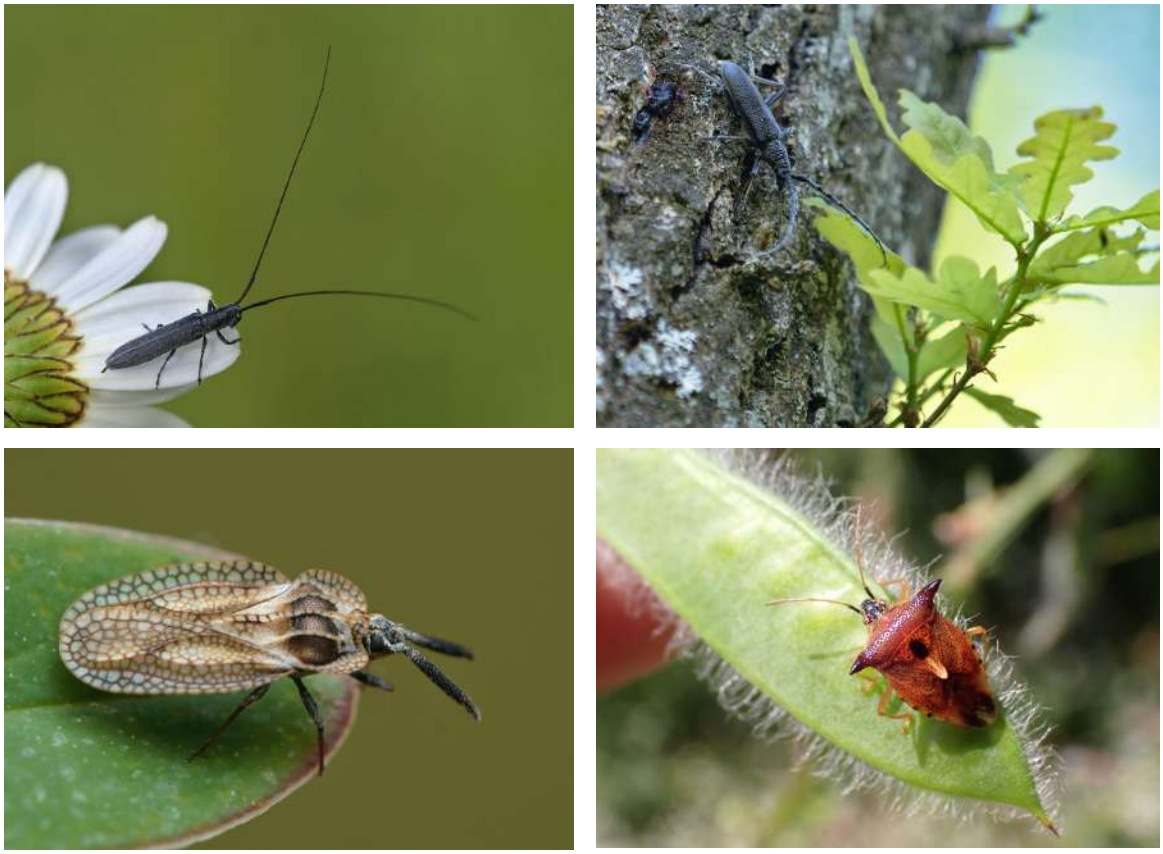
A lot of **true bug** species have been observed during the inventories. Among them, some rare or very rare in Wallonia (or Belgium) are noteworthy. ***Aelia klugii*** a very rare species which feeds on a wide range of grass species, was found in Tenneville. ***Elasmucha ferrugata*** a rare species which feeds in particular on blueberries, was observed in the Bois Huqueny. Among the specialised species, we can also mention ***Dictyonota strichnocera,*** which was observed in Lavacherie. This very rare species lives on several *Fabaceae* species regularly found in electrical corridors: *Cytisus scoparius* and *Genista spp.* Furthermore, ***Stagonomus bipunctatus pusillus*** is another rare bug feeding among others on *Veronica officinalis*. It was found in Nassogne-Tenneville, Doische, Winenne, Andenne, Oppagne and Langlire. Finally, we found the very rare ***Catoplatus fabricii***, whose only host plant is *Leucanthemum vulgare*, in Rochefort, Aye and Oppagne.

In the ladybird family, 2 species deserve mentioning. ***Coccinella hieroglyphica*****,** a protected species in Belgium, lives in wetlands and has a scattered distribution range in Belgium. It has been found in 4 Elia sites: Wamme (central Ardenne), Amcômont and Porallée (in the higher altitudes) and Mellier (south of Ardenne). Its presence testifies the quality and stability of the wet heathland habitat. ***Coccinula quatuordecimpustulata***, considered as a good indicator species for poor grasslands, on quite acidic and dry soils, is quite often found in open areas in forest corridors and is found on 24 sites.

Regarding beetles,our surveys also considered the longhorn beetles. The rare ***Cerambyx scopolii*****,** that feeds on flowers at forest edges, has been observed laying eggs in the forest edge in a green corridor in Anhée, then taking off and flying straight in the axis of the line. Since its populations are located in this region in the short vicinity of the Meuse, this observation allows us to hypothesise that this beetle uses the straight, easy flight routes offered by Ecological corridors to colonise new territories. Another very rare species, ***Xylotrechus antilope***, was seen in the same corridor in Anhée where it takes advantage of the well exposed oaks on the edges. ***Calamobius filum***, a rare species linked to herbaceous, dry and nutrient-poor habitats, was found in such a meadow in Freylange, while it only recently appeared in Belgium. Finally, 2 quite rare species, ***Anoplodera sexguttata*** and ***Oberea linearis*** were found in Mellier and Couvin respectively.

The **European stag beetle (*Lucanus cervus*),** an Annex II Natura 2000 species, was once observed in Ramioul. This spectacular and rare species is xylophagous at its larval stage, and lives in the tree stumps or dead remnant wood.

The rare leaf beetle ***Calomicrus circumfusus*** was found in Boumont (Tenneville) and Rochefort. This species is known only in a few localities south of the Sambre-and-Meuse line. It lives in heathlands, grasslands, and open forest habitats, and reproduces on ***Genista*** *and* ***Cytisus*** plant species that are quite common in Ecological corridors.



Figures 4.10. Several other rare species have been seen in the forest corridors, without any specific monitoring scheme.
(Left-top) Calamobius filum - *(Right-top)* Cerambyx scopolii
(Left-down) Dictyonota strichnocera - *(Right-down)* Elasmucha ferrugata

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Take-home messages

The biodiversity in the Elia forest corridors is often high. The richness and the rarity of species observed emphasise the significant contribution of the power line grid to nature conservation in Belgium, particularly in the context of the population movements induced by climate changes.

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We observed :

- **111 species** from the **Walloon Red List of Threatened Species**, for the 6 main monitored taxonomic groups
- **14 species targeted by Natura 2000** : annex II Habitat Directive or Annex I Bird Directive
- 8 different species of amphibians, 4 reptiles, 67 birds, 38 dragonflies, 16 bats
- One record on one site of 151 plants and 43 butterflies

5. Appendix

Appendix 1.

The below table presents the threatened species, their status, and the number of sites (LIFE Elia sites and Ecological corridors sites) where this species has been observed during the LIFE period and after the LIFE ended. The status are as followed :

- For the Walloon Red List : Nearly Threatened (NT), Vulnerable (VU), Endangered (EN), Critically Endangered (CR), Regionally extinct (RE) and Least Concern (LC - not in the Red List)
- For Natura 2000: the species listed in the Annex II of the Habitat Directive 92/43/EEC (HD - II) and the species listed in the Annex I of the Bird Directive 2009/147/EC (BD - I)

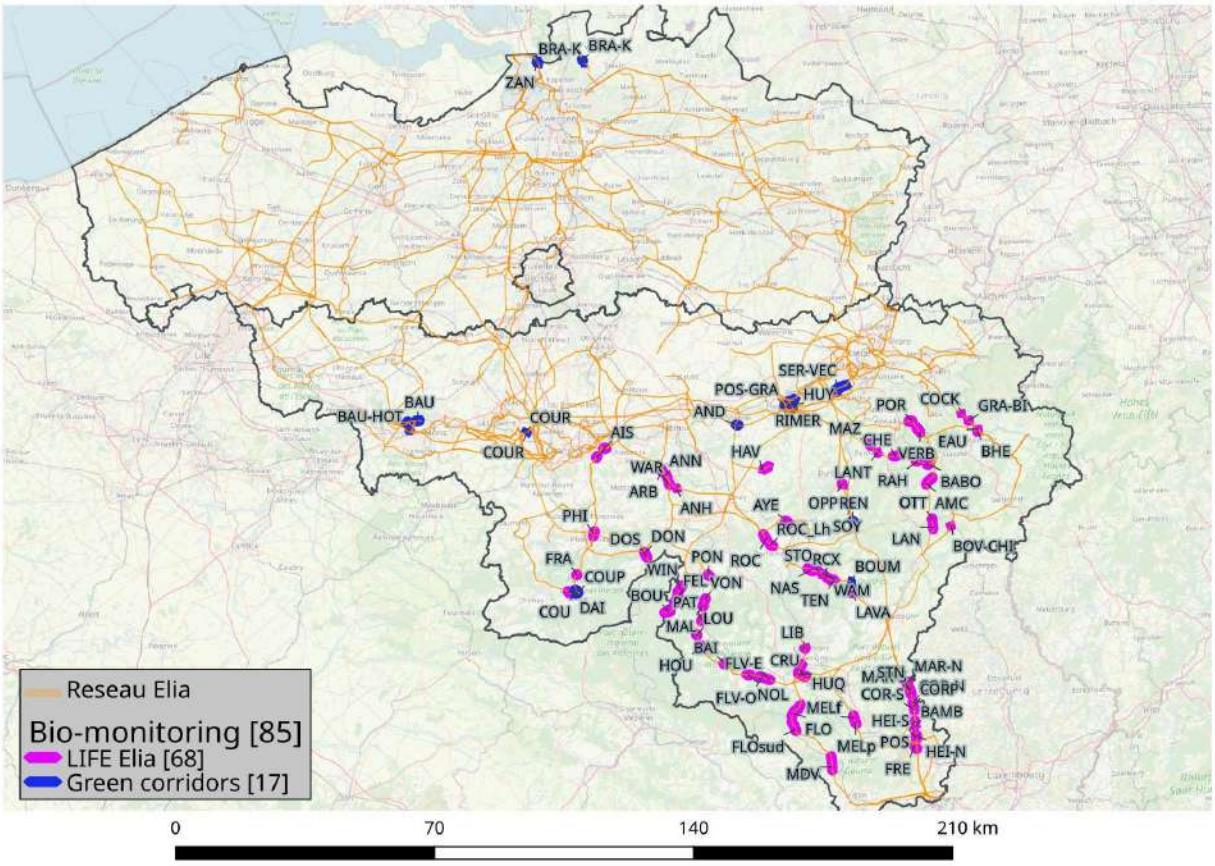
Taxonomic group	Species	Walloon Red List	Natura 2000	number of sites (period 2011-2017)	number of sites (period 2018-2022)
Amphibian	Triturus cristatus	NT	HD - II		1
Bats	Myotis alcathoe	VU			2
Bats	Myotis myotis	VU	HD - II	3	6
Bats	Nyctalus noctula	VU			4
Bats	Plecotus austriacus	VU		1	4
Bats	Rhinolophus ferrumequinum	VU	HD - II	1	2
Bats	Eptesicus serotinus	NT		4	14
Bats	Myotis bechsteinii	NT	HD - II	1	2
Bats	Myotis daubentoni	NT			4
Bats	Myotis emarginatus	NT	HD - II		4
Bats	Nyctalus leisleri	NT		3	12
Bats	Pipistrellus nathusii	NT		4	12
Birds	Dryocopus martius	LC	BD - I	3	2
Birds	Falco peregrinus	LC	BD - I	1	
Birds	Cuculus canorus	EN		3	3
Birds	Streptopelia turtur	EN		4	1
Birds	Carduelis flammea	VU		1	
Birds	Milvus migrans	VU	BD - I		1
Birds	Phylloscopus trochilus	VU		7	7
Birds	Poecile montanus	VU		2	3
Birds	Accipiter nisus	NT		1	
Birds	Carduelis spinus	NT		2	
Birds	Chloris chloris	NT			1
Birds	Ciconia nigra	NT	BD - I	1	
Birds	Emberiza citrinella	NT		5	5
Birds	Milvus milvus	NT	BD - I		1
Birds	Sylvia borin	NT		6	6
Birds	Turdus pilaris	NT			1
Butterflies	Cupido argiades	RE		1	3
Butterflies	Satyrium ilicis	CR		1	1
Butterflies	Argynnis aglaja	EN		3	3
Butterflies	Boloria dia	EN		1	4
Butterflies	Argynnis adippe	VU		3	6
Butterflies	Boloria aquilonaris	VU		1	1
Butterflies	Boloria eunomia	VU		2	
Butterflies	Boloria euphrosyne	VU		2	1
Butterflies	Coenonympha arcania	VU		4	9
Butterflies	Colias alfacariensis	VU		1	
Butterflies	Hamearis lucina	VU		1	1
Butterflies	Iphiclides podalirius	VU		2	1
Butterflies	Lycaena helle	VU	HD - II	1	
Butterflies	Lycaena hippothoe	VU		1	4
Butterflies	Melitaea athalia	VU		1	1
Butterflies	Polyommatus coridon	VU		1	
Butterflies	Pyrgus malvae	VU		11	5
Butterflies	Boloria selene	NT		16	14
Butterflies	Callophrys rubi	NT		4	8
Butterflies	Cupido minimus	NT		2	1
Butterflies	Erynnis tages	NT		3	
Odonates	Lestes dryas	VU			2
Odonates	Lestes virens	VU			1
Odonates	Sympetrum vulgatum	VU		1	
Odonates	Aeshna juncea	NT		1	1
Odonates	Gomphus vulgatissimus	NT			1
Odonates	Leucorrhinia dubia	NT		2	4

Taxonomic group	Species	Walloon Red List	Natura 2000	number of sites (period 2011-2017)	number of sites (period 2018-2022)
Higher plants	Ajuga pyramidalis	CR			3
Higher plants	Andromeda polifolia	CR			1
Higher plants	Carex binervis	CR			4
Higher plants	Carex viridula	CR			11
Higher plants	Centunculus minimus	CR			1
Higher plants	Cicendia filiformis	CR			1
Higher plants	Corynephorus canescens	CR			1
Higher plants	Crepis foetida	CR			1
Higher plants	Euphorbia platyphyllos	CR		1	1
Higher plants	Juncus tenageia	CR			1
Higher plants	Lycopodiella inundata	CR			1
Higher plants	Orchis simia	CR			1
Higher plants	Orobanche caryophyllacea	CR		1	1
Higher plants	Potamogeton gramineus	CR			1
Higher plants	Ranunculus trichophyllus	CR			1
Higher plants	Rosa agrestis	CR			1
Higher plants	Stachys recta	CR		1	1
Higher plants	Thlaspi montanum	CR		1	
Higher plants	Alopecurus aequalis	EN			1
Higher plants	Bromus racemosus	EN			1
Higher plants	Bunium bulbocastanum	EN			1
Higher plants	Carex humilis	EN			1
Higher plants	Carex tomentosa	EN			1
Higher plants	Dryopteris cristata	EN			1
Higher plants	Epipactis purpurata	EN			1
Higher plants	Gentianella ciliata	EN		1	
Higher plants	Geranium sanguineum	EN			1
Higher plants	Narthecium ossifragum	EN		2	2
Higher plants	Ophioglossum vulgatum	EN		2	1
Higher plants	Ophrys fuciflora	EN		1	1
Higher plants	Ophrys insectifera	EN		2	
Higher plants	Orchis purpurea	EN			1
Higher plants	Platanthera bifolia	EN		1	3
Higher plants	Prunus mahaleb	EN			1
Higher plants	Quercus pubescens	EN			1
Higher plants	Rosa rubiginosa	EN			2
Higher plants	Rosa tomentosa	EN			1
Higher plants	Scorzonera humilis	EN		1	
Higher plants	Vaccinium oxycoccos	EN			1
Higher plants	Agrimonia procera	VU			2
Higher plants	Anacamptis pyramidalis	VU		2	4
Higher plants	Callitriche hamulata	VU			2
Higher plants	Callitriche platycarpa	VU			1
Higher plants	Carex canescens	VU			6
Higher plants	Carex flava	VU			2
Higher plants	Centaurea montana	VU			1
Higher plants	Dactylorhiza fuchsii	VU			3
Higher plants	Dianthus armeria	VU			1
Higher plants	Erica tetralix	VU		2	11
Higher plants	Gymnadenia conopsea	VU			1
Higher plants	Juniperus communis	VU			2
Higher plants	Lonicera xylosteum	VU		1	1
Higher plants	Lycopodium clavatum	VU		1	1
Higher plants	Ophrys apifera	VU		1	1
Higher plants	Orobanche rapum-genistae	VU			2
Higher plants	Potamogeton berchtoldii	VU			1
Higher plants	Potamogeton polygonifolius	VU			4
Higher plants	Trichophorum cespitosum	VU			1

Appendix 2.

Biological monitoring sites

1. Map of localisation



2. List of the sites

Content of the columns

- **CodeSite**: codes used in the report
- **NomSite**: names of the place
- **LIFEact**: main LIFE action in each site (i.e. the most important in terms of surface)
- **StepLIFE**: abbreviation for LIFE Elia-RTE (“LIFE1”) and Ecological corridors (“LIFE2”)
- **Success**: evaluation of the success of the restoration actions/management (see section 2): failure (0); status quo (1); good evolution (2); not evaluated (NA)
- **BenefBiol**: a global evaluation of the biological gain due to the restorations/management (see section 2): neutral (0); good evolution (1); exceptional (2); not evaluated (NA)
- **X** and **Y**: longitude and latitude in metres (projection Lambert 72) of the centroid

CodeSite	NomSite	LIFEact	StepLIFE	Success	BenefBiol	X	Y
AIS	Aiseau-Presles	lisière restaurée	LIFE1	1	0	164106	120752
AIS	Aiseau-Presles	lisière restaurée	LIFE1	1	0	166318	123020
AMC	Amcômont	Prairie pâturée	LIFE1	2	1	253685	114181
AND	Andenne	Lisières plantées	LIFE2	NA	NA	201992	129353
ANH	Anhée (Yvoir)	Pelouse calcicole	LIFE1	1	0	185636	112192
ANN	Annevoie	lisière restaurée	LIFE1	NA	NA	183060	115285
ARB	Arbre	Lisières plantées	LIFE1	2	1	181675	116988
AYE	Aye	Prairie maigre et mares	LIFE1	2	2	215538	103041
BABO	Basse-Bodeux	Prairie pâturée	LIFE1	2	2	252797	118962
BAI	Baillamont	Prairie fleurie	LIFE1	2	1	198585	64728
BAMB	Bambesch (Attert)	Diverses (prairie fauchée, lisière, mare)	LIFE1	2	1	250222	47647
BAU	Baudour	lisière restaurée	LIFE2	1	0	115549	130486
BAU	Baudour	lisière restaurée	LIFE2	1	0	112736	130039
BAU-HOT	Près de la Hottière (Baudour)	Creusement de mare	LIFE2	NA	NA	113496	127850
BHE	Eau Rouge - Bois de la Hé	Lande humide tourbeuse et mares	LIFE1	2	1	266801	127649
BOU	Boursoigne-Neuve	Lisières plantées	LIFE1	1	0	183173	78771
BOUM	Boumont (Tenneville)	Prairie fleurie	LIFE2	2	1	232845	86724
BOV-CHI	Bovigny (Gouvy)	Diverses	LIFE1	1	0	259783	102000
BRA-K	Braschaat-Kalmthout	lisière restaurée	LIFE2	NA	NA	160642	227315
BRA-K	Braschaat-Kalmthout	lisière restaurée	LIFE2	NA	NA	160173	228009
CHE	Chevron	Lande humide tourbeuse et mares	LIFE1	2	1	244762	120970
COCK	Cockaifagne	Diverses (prairie fauchée, lisière, mare)	LIFE1	1	0	262613	132460
COR-N	Martelange (Corne du Bois)	Prairie maigre	LIFE1	2	2	249590	54109
COR-S	Martelange (Corne du Bois)	Prairie maigre	LIFE1	2	2	249867	52586
CORP	Martelange (Corne du Bois)	Prairie pâturée	LIFE1	2	1	249749	53312
COU	Couvin	Pelouse calcicole	LIFE2	2	1	158620	84479
COUP	Couvin pâturage	Pelouse calcicole	LIFE2	2	2	158693	83911
COUR	Trazegnies (Courcelles)	Diverses (prairie fauchée, lisière, mare)	LIFE2	1	0	145065	127606
COUR	Trazegnies (Courcelles)	Diverses (prairie fauchée, lisière, mare)	LIFE2	1	0	144997	127182
CRU	Les Cruserelles	Prairie fleurie	LIFE1	1	1	220306	61293
DAI	Dailly	lisière restaurée	LIFE1	2	2	156607	83989
DON	Doische Nord	Creusement de mare	LIFE1	2	2	177060	94698
DOS	Doische Sud	Creusement de mare	LIFE1	2	2	177439	93914
EAU	Eau Rouge - Nord	Lande humide tourbeuse et mares	LIFE1	2	1	267102	128230
FEL	Felenne	Diverses (prairie fauchée, lisière, mare)	LIFE1	1	1	185317	81660
FLO	Florenville	Prairie fleurie	LIFE1	2	1	218090	52277
FLOsud	Florenville Sud	Prairie fleurie	LIFE1	2	2	217536	47808
FLV-E	Fays-les-Veneurs Est	Prairie maigre	LIFE1	2	2	210548	60452
FLV-O	Fays-les-Veneurs Ouest	Prairie maigre	LIFE1	2	2	208705	61043
FRA	Frasnes	Lisières plantées	LIFE1	0	0	158693	88846
FRE	Freylange	Diverses (prairie fauchée, lisière, mare)	LIFE1	2	2	250341	42077
GRA-BI	Hockai-Grand Bieu (Stavelot)	Tourbière	LIFE1	2	1	264637	130602
HAV	Havelange	Lisières plantées	LIFE1	1	1	210087	117872
HEI-N	Heinsch Nord	Prairie fleurie	LIFE1	2	1	250371	45584
HEI-S	Heinsch Sud	Prairie fleurie	LIFE1	2	2	250452	44658
HOU	Houdremont	Prairie fleurie	LIFE1	2	1	192580	69333
HUQ	Bois d'Huqueny	Prairie fleurie	LIFE1	2	2	218906	63298
HUY	Huy	lisière restaurée	LIFE2	1	NA	216551	134835
LAN	Langlire	Lande humide tourbeuse et mares	LIFE1	2	1	254933	101832
LANT	Lantroule (Ferrières)	Lisières plantées	LIFE1	1	1	240060	121894
LAVA	Lavacherie-Ortheuville	Lisières plantées	LIFE1	2	1	232979	84529
LIB	Libramont	Prairie fauchée	LIFE1	2	1	220394	69085
LOU	Louette	Prairie fleurie	LIFE1	2	1	191057	72634
MAL	Malvoisin	lisière restaurée	LIFE1	1	0	192790	80407
MAR-N	Martelange (Radelange)	lisière restaurée (en plein)	LIFE1	1	1	247861	59468
MAR-S	Martelange sud (Hounscht)	Prairie pâturée	LIFE1	2	2	248979	56790
MAZ	So Mazeri (Ferrières)	Diverses (prairie pâturée, lisière, mare)	LIFE1	2	0	237866	124058
MDV	Meix-devant-Virton	lisière restaurée	LIFE1	1	0	227630	37932
MELf	Mellier	Prairie fleurie	LIFE1	2	2	233584	50175
MELp	Mellier	Prairie pâturée	LIFE1	1	1	233979	49082
NAS	Nassogne	Lisières plantées	LIFE1	1	1	221550	90185
NOL	Nollevaux	Prairie fleurie	LIFE1	2	1	205069	61781
OPP	Oppagne (Durbuy)	lisière restaurée	LIFE1	1	1	230516	113169
OTT	Ottré	lisière restaurée (en plein)	LIFE1	1	0	254739	103816
PAT	Patignies	Prairie fleurie	LIFE1	2	1	192670	77129
PHI	Philippeville	Lisières plantées	LIFE1	2	1	163283	99953
PON	Pondrôme	Pelouse calcicole	LIFE1	2	2	194276	88696
POR	Porallée	Prairie maigre et mares	LIFE1	2	2	248510	130386
POS	Post	Prairie fleurie	LIFE1	2	2	250086	49128
POS-GRA	Bois de Thiange (Poste de Gramme)	NA	LIFE2	NA	NA	214993	134519
RAH	Fagne Magrite	Prairie pâturée	LIFE1	2	1	250752	119547
RCX	Rouge Croix	Lisières plantées	LIFE1	2	2	226443	87995
REN	Rendeux	lisière restaurée (en plein)	LIFE2	1	0	233220	103355
RIMER	Ri de Mer (Amay)	Prairie pâturée	LIFE2	1	0	217460	136314
ROC	Rochefort	Prairie maigre et mares	LIFE1	2	2	209531	98882
ROC_Lh	Rochefort (Lhoist)	lisière restaurée	LIFE1	1	1	211213	96743
SER-VEC	Seraing	Diverses (prairie fauchée, lisière, mare)	LIFE2	2	NA	229372	139338
SOY	Soy - Erezée	Lande humide et mares	LIFE2	2	1	232087	108035
STN	Martelange (St-Nicolas)	Prairie fauchée	LIFE1	1	1	248629	57896
STO	Fontaine aux Stok	Lande humide tourbeuse et mares	LIFE1	2	1	224123	69843
TEN	La Converserie (Tenneville)	Lisières plantées	LIFE1	2	1	228128	87383
VERB	Vert-Buisson	Lande humide, lisières restaurée et mares	LIFE1	2	1	251107	127849
VON	Vonêche	Creusement de mare	LIFE1	2	2	193219	82029
VON	Vonêche	Creusement de mare	LIFE1	2	2	193443	82292
WAM	Wamme	Lande à callune	LIFE1	2	2	225183	88904
WAR	Warnant	lisière restaurée	LIFE1	1	0	183609	113421
WIN	Winenne	Lande à callune	LIFE1	2	1	186753	85290
ZAN	Zandvliet	lisière restaurée (en plein)	LIFE2	NA	NA	148198	227247