



LIFE14 NAT/BE/000364

Final Report
Covering the project activities from 01/10/2015 to 31/12/2021

Reporting Date
31/03/2022

LIFE in Quarries

Data Project

Project location:	Wallonia, Belgium
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Project end date:	30/09/2020 Extension date: 31/12/2021
Total budget:	5,036,188 €
EU contribution:	2,825,558 €
(%) of eligible costs:	59.80%

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II. Indexes

II.1. List of keywords and abbreviations

CR	Critically Endangered status
DD	Data Deficient status
DEMNA	Department of Natural and Agricultural Environment Studies, Walloon region
DNF	Department of Nature and Forests, Walloon region
EC	European Commission
ES	Ecosystem services
EU	European Union
FEDIEX	Belgian federation of the extractive industry
LiQ	LIFE in Quarries
PNPE	Parc Naturel des Plaines de l'Escaut
ULiège-GxABT	University of Liège – Gembloux Agro-Bio Tech
VU	Vulnerable status
WR	Walloon region

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III. Executive Summary

The extractive activity of quarries represents an exceptional opportunity to maintain rare and endangered habitats with its associated pioneer species. Indeed, the operation of a quarry produces a wide variety of temporary habitats, sometimes evolving towards more permanent communities.

On its own initiative, the extractive industry requested more understanding for biodiversity management on its sites. To answer this demand, a partnership was created between the Belgian Federation of Industry Extractive (FEDIEX), University of Liège, Natagora, the Parc naturel des Plaines de l'Escaut (PNPE) and the Walloon region in the framework of LIFE in Quarries project (LIFE14 NAT/BE/000364).

For 6 years, the project has lead the private sector, public authorities, and non-governmental associations to work together to demonstrate that operational solutions can be proposed for biodiversity management and implemented through limited investments benefiting the industrial sector and stakeholders interested by nature. The overall objective was to define acceptable measures for operators, being legally and scientifically valid, and of course favorable to biodiversity.

In doing so the project aimed at creating a win-win for nature and the industry situation where quarries could act as a network of sites:

- (i) significantly contributing to the management of pioneer biodiversity at the regional level;
- (ii) promoting post exploitation restoration during the exploitation phase that would enhance both biodiversity *per se* and ecosystem services provisions - thus participating to the development of a regional Green Infrastructure;
- (iii) promoting awareness of its members on biodiversity stakes at play and means to favor it in quarries; while,
- (iv) securing the long term management through the legal securing of the dynamic management of biodiversity throughout the exploitation phase and the provision of adequate tools for monitoring outcomes, allowing for protected species to co-exist with the exploitation.

Favoring in return a better understanding from the Laymen on the role quarries could play for biodiversity, through dissemination actions.

The project was characterized by the launching and the implementation of concrete conservation actions in 27 quarries. During the project, a dedicated team worked on the general coordination (F.1), preparatory actions (A.), communication (E.) and initiation of concrete conservation actions (C.1, C.2, C.3), further monitoring the outcomes of the project and securing its future (D.).

The **preparatory actions** delivered important results for further implementation.

- **It prepared actions to be** tested under action C.1 based on the detailed assessment of the state of the art and initial workshop (action A.1);
- The establishment of indicators (action A.2) oriented the adequate monitoring of the project progress;
- In-depth biological inventories (action A.3) helped properly orientate the action plans implemented in C.2 to C.4 actions;
- The legal study (action A.4) identified the potential legal obstacles to the concept of dynamic management of biodiversity with a comparison of similar initiatives in other European countries;
- The preparation of dissemination actions was linked to the development of a quarry network (A.5);
- The evaluation of Ecosystem services provided a new methodology to evaluate ES in quarries and its implementation allowed the full understanding of impact of restorations choices on services delivered.

Concrete conservation actions were implemented on 27 sites and disseminated in 7 EU sites:

- After a testing period for the implementation of concrete conservation actions (C.1), the pilot phase run in 14 quarries with individually adapted action plans (C.2-C.3) by the quarry operators with a close supervision of the LIFE project's team. Actions were mostly implemented behind initial expectations;
- The transfer to 13 Phase II quarries in a smoothed scheme allowed confirming the feasibility of the process, further delivering beyond expectations in C.4a.
- With experience and multiple case studies in mind, in C.4b the project could then propose a way forward in 7 EU quarries from 3 different countries with positive outcomes and propositions for future implementation.

Monitoring of actions allowed confirming the benefits brought from realizations:

- C.1 tests evaluated under action D.1 helped reorient the implementation of C.2-C.3 actions;
- The monitoring of biological outcomes under D.2 confirmed the rapid interest of temporary nature actions (C.2) actions while providing good omen for the trajectories taken by permanent nature (C.3) restorations;
- The assessment of the Ecosystem services (D.3) development throughout the project provided much interesting information on the positive and negative impacts quarries can have on the development of ES and on ways these could be influenced through specific information, habitats restoration and exchanges between the sector and other stakeholders favoring an integration into a regional Green Infrastructure.
- Associated to the development of a strong framework of management plans, derogations and commitments under charters under action D.5, the development of the Ambres platform for the basic monitoring (D.4) and its appropriation by quarries personnel will allow for the actions to live on in the After-LIFE;
- The increased awareness of the sector on the role they can play for biodiversity present on their site, as a result of Communication actions, monitored under action D.6b is further expected to allow quarry staff to become stewards of their sites' biodiversity. Accompanied by guidance on the evaluation of means and costs necessary for the implementation of dynamic management of biodiversity (under D.6c) these outcomes are expected to encourage and facilitate new quarries to join the process.

Communication and training of the project were based on different supports and sharing methods:

- Training activities and methodological documents, factsheets and an online picture database of species aimed at favoring the quarries operators understanding of stakes and means to favor biodiversity in quarries (E.5a & E.5c). The project trained quarry personnel at all hierarchical levels in the societies, from workers to CEOs ;
- The communication towards others actors involved in the sector went through Networking with other projects (E.3), sharing with and training of public authorities (E.5b) and multiples attendances to conferences and oriented events (E.6a); This helped facilitate contacts of these actors with the sector and promote a mutual understanding on commitments for biodiversity;
- Some notice boards (E.1), the website (E.2), the Layman's report (E.4) as well as a project folder, newsletters, a presence in the press, open quarry days and observation platforms (E.6) aimed at informing a broader audience to biodiversity in quarries and the outcomes of the project;
- To disseminate at a broader EU level the outcomes of the project, the LIFE in Quarries team relied as well on Networking (E.3), EU Working groups (E.7) and a final International workshop (E.8).

The project partners contributed jointly to the reaching of the project's objectives and to favoring further developments through joint commitments in the After-LIFE plan (F.3).

By doing so, we set the basis for the project's realizations and the *Innovative partnership for biodiversity, people and economy* to live on within the project's area and abroad. The recent Commission '*Guidance document on the strict protection of animal species of Community interest under the Habitats Directive*' and future intakes of the project outputs are expected to favor biodiversity and its provision of Ecosystem services in a win-win situation for nature and the sector.

IV. Introduction

IV.1. Description of background, problems, and objectives

IV.1.1. Overall and specific objectives

The extractive industry generates a large diversity of habitats acting as providers of biodiversity and ecosystem services, as steppingstones in highly urbanized and controlled landscapes. Indeed, active quarries offer an exceptional opportunity to maintain rare and threatened transient habitats hosting fugitive species.

As exploitation progresses, more permanent, biodiverse habitats settle in abandoned areas, but the biological potential could also be maximized by optimizing groundwork through the whole exploitation process.

The LIFE in Quarries project aimed at bringing and answer to the lack of knowledge of the biodiversity potential in quarries. In doing so, it identified the main following targets:

Target 1: Test and define methods allowing the restoration, maintenance and management of fugitive species and pioneer habitats to maximize quarry biodiversity hosting capacity and stepping-stones role in the ecological network by:

- identifying pre-existing experiences through an initial phase and workshop (action A.1) and defining indicators (A.2);
- identifying main stakes for 12 quarries (A.3);
- testing the creation and maintenance of temporary nature (C.1);
- monitor C.1 and adapt techniques (D1);
- implementing adapted methods at large scale (C.2) and monitor (D.2);
- update annually management plans, promote its adoption by quarries and promote quarry charters (D.5);
- generalizing locally and internationally (C.4);
- redacting methodological documents and folders on the topic and train biodiversity responsible (E.5).

Target 2: Test and define methods to prepare the physical quarry infrastructure, during the exploitation process, in order to facilitate the establishment of restoration plans that will increase Ecosystem Services delivery and maximize stable and biodiversity-rich ecosystems in the post-exploitation phase by:

- identifying existing permanent actions enhancing ecosystem services (ES) and defining a series of indicators (A.2);
- identifying permanent nature stakes for member quarries (A.3);
- evaluating the importance of quarries in the landscape for ES and Green Infrastructure (A.6);
- implementing at large scale methods (C.3), monitoring ES evolution (D.3) and generalizing (C.4);
- disseminating and training to post-exploitation nature in quarries (E.5).

Target 3: Identify lock-in situations like legal constraints, biodiversity management awareness, technology and management innovations, security problems for cultural ecosystem services development, administration position on changes of exploitation plans, civil society reaction to new extension plans, ... preventing the adoption of explicit new management measures by:

- analyzing quarry exploitation plans, legal obligations and opportunities (VI.1.A.3b, A.4);
- studying the Walloon and EU legislation on temporary nature management and proposing legal solutions to adapt legislative lock-ins (A.4);
- integrating target 1 and 3 in the redaction of contractual quarry managers-administration charters (D.5).

Target 4: Raise awareness of quarry managers, administration managers, local stakeholders for ephemeral biodiversity management during all stages of the exploitation process by:

- creating a quarry network (A.5) integrating target audiences;
- conducting to the adoption of methods (E.5), of basic monitoring (D.4) and of management plan updating (D.5) by quarries;
- disseminating outcomes to a broad audience by: notice boards (E.1), website (E.2), Networking (E.3), Layman's report (E.4), Training (E.5), Increased public awareness (E.6), involving EU stakeholders through a EU working group (E.7) and an international workshop (E.8).

Target 5: Demonstrate that good practices dissemination is effective by adapting management through the whole exploitation process for a selection of Belgian quarries but also in several European countries by:

- informing partners right from the start with an initial workshop (A.1);
- developing local and broad audience networks (A.5-E.3E.2);
- actively promoting (E.7) outcomes at the EU level;
- monitoring impacts in a sector socio-cultural initial and final survey (D.6);
- ensuring active After-LIFE (F.3) dissemination by launching the process during the project.

a. Expected results

Specifically, the project targeted the delivery of coherent management of biodiversity for 24 quarries of the Walloon Region through:

- Signature of charters on the maintenance of temporary habitats during the life of the quarries (D.5)
- Inventories of main stakes and LIFE IN QUARRIES management plans for 24 quarries (A.3)

Dynamic management of (C.2):

- 120 temporary ponds;
- 12 ha of pioneer grasslands habitats;
- 10 banks of loose materials for solitary bees and sand martin reproductions;
- 5 ha of screes with pioneer vegetation of the *Alyssa sedion*;
- 8 species of the heritage flora reproduced and sown in sites;
- 96 fauna shelters;
- 4 translocated populations of *Bufo calamita* and 4 translocated populations of *Triturus cristatus*;
- Breeding of 1 population of *Bombina variegata*;

Permanent actions (C.3):

- Creation of 24 ponds larger than 25 m²;
- Creation of adequate conditions for the installation of 400 m of reedbeds on deep quarry lakes;
- Installation of 16 terns platforms;
- Securing 4 galleries for chiropters;
- Installation of 50 ha of infrastructures for the grazing of pastures and diversification of habitats structure;
- Floristic diversification and installation of 10 ha of infrastructures of mowed grasslands;
- Setting up of 8 km of linear screes adapted to reptiles;

Sector training (E.5):

- Training of CEOs, biodiversity responsible, worker and EU partners to the management and basic monitoring of temporary nature in each of the 24 quarries;
- Producing a Methodological document on the creation and management of temporary habitats in quarries;
- Factsheets on temporary habitats management to the use of quarry workers;
- Videos on the management of temporary habitats to the use of quarry workers;
- Developing an online picture database;

External communication (E.1, E.2, E.6):

- 28 notice boards at strategic communication place;
- Website for the broad audience;
- General folder on the project;
- Layman's report;
- 5 Video clips on temporary/permanent habitats;
- 10 Newsletters;
- Installation of 3 observation platforms;
- Setting up of 72 open quarry days for the general audience;
- A general awareness campaign;
- An international workshop;

Elaboration of:

- Inventories of actual and potential ecosystem services provided by the extractive industry (A.6);
- An analysis of the quarry network contribution to Green infrastructure (D.3);
- Analysis of the legal framework (A.4);

Dissemination:

- Transfer to sister federation through an European Working Group and site visit and training (E.7);
- Reproduction of the temporary management to 3*2 quarries outside of the Walloon Region (C.4b);

IV.1.2. Project area

The LIFE in Quarries project has been active in 27 quarries sites distributed across Wallonia, covering the main diversity of rock type exploitations.

The participating quarries were involved in 2 phases (see Table 1 and Figure 1):

- **Pilot phase** involved 14 quarries to test and implement concrete conservation actions for the temporary (C.2) and permanent (C.3) nature management plan;
- **Demonstration phase** concerned 13 sites to generalize and replicate the outcome of the pilot phase.

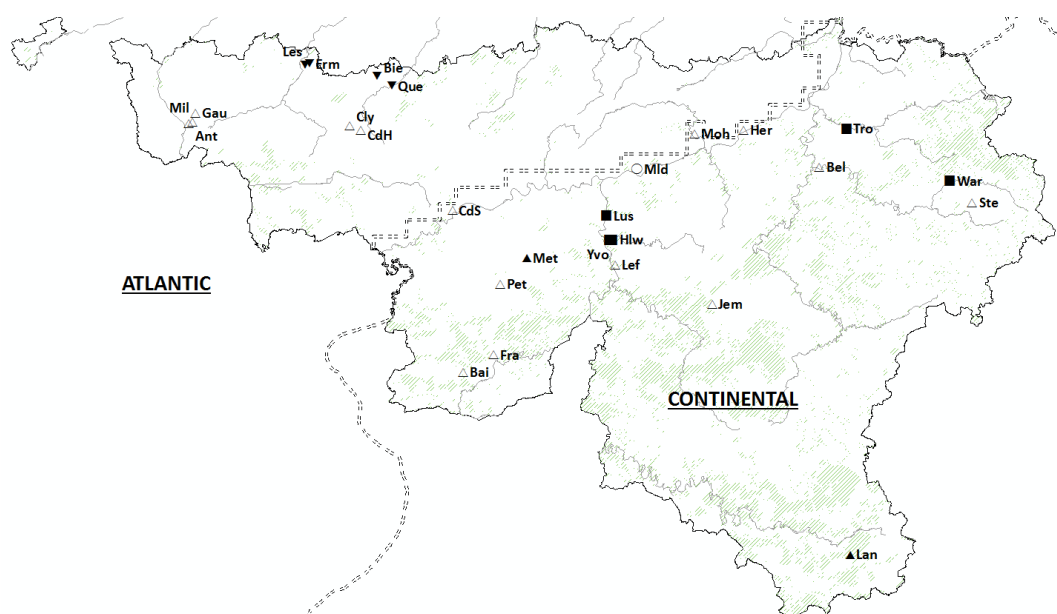


Figure 1. Map of participating quarries in both Walloon biogeographical districts. Codes relate to Table 1.

Table 1. Quarry companies and their sites involved in the project as affiliated entities to FEDIEX.

Affiliated entity	Quarry site	Code	Phase
CARRIERES ET FOURS A CHAUX DUMONT-WAUTIER SA	Hermalle	DWH/HER	I
DOLOMIES DE MARCHE-LES-DAMES SA	Marche-les-Dames	MLD	II.1
LHOIST INDUSTRIE SA	Jemelle	LHI/JEM	II.1
CARMEUSE SA	Moha	MOH	I
	Frasnes	FRA	II.1
CARRIERES UNIES DE PORPHYRE	Bierghes	BIE	I
	Baileux	BAI	I
	Lessines	LES	II.2
COMPAGNIE DES CIMENTS BELGES SA (CCB)	Clypot	CLY	I
	Gaurain	GAU	II.1
CARRIERES LES PETONS SPRL	Les Petons	LPT/PET	I
SAGREX (CBR)	Lustin	LUS	I
	Quenast	QUE	II.1
	Antoing	ANT	II.1
HOLCIM Belgique	Milieu	MIL	I
	Trooz	TRO	I
	Leffe	LEF	II.1
	Ermitage	ERM	II.2
CALCAIRES DE LA SAMBRE	Landelies	CAS/CDS	I
CARRIERES DU HAINAUT	Soignies	CDH	I
SABLIERES LANNOY	Chatillon	LAN	I
SECY	Yvoir	YVO	I
TRAGECO	Steinbach	STE	I
NELLES Frères	Warche	WAR	II.1
SCR-SIBELCO	Mettet	MET	II.1
BELLE ROCHE SABLAR SA	Belle-Roche	BRS	II.1
HAUT LE WASTIA SA	Haut-le-Wastia	HLW	II.2

IV.1.4. Targeted habitats and species

Habitats

Through their daily exploitation, quarries constantly initiate a succession process generating adequate abiotic conditions for the installation of a diverse flora and fauna through the creation of habitats analogous to natural and semi-natural habitats.

Depending on the date of the last perturbation (excavation and/or movement of material), a mosaic of rare and threatened transient habitats is created. The following Natura 2000 habitats or their analogues are frequently represented:

- 3140 - Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.;
- 3150 - Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation;
- *6110 - Rupicolous calcareous or basophilic grasslands of the *Alyso-Sedion albi*;
- 6210 - Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites);
- *8160 - Medio-European calcareous scree of hill and montane levels;
- 8210 - Calcareous rocky slopes with chasmophytic vegetation;
- (9180 - *Tilio-Acerion* forests of slopes, screes, and ravines.)

Other natural and anthropic habitats including old lime-kilns or galleries that can shelter chiropters associated to caves are also represented.

Species

The large diversity of habitats potentially concerned and the large distribution of the LIFE in Quarries project make it impossible to provide an exhaustive list of species potentially affected. A list of targeted species closely linked to the presence of pioneer, rocky habitats and surrounding habitats of quarries was planned to be elaborated over the course of the project.

The project targeted the development of the following stakes:

Botanical

The botanical richness of quarry sites has been recognized for some time now. The list of vascular and non-vascular plants potentially benefiting from the LIFE in Quarries project is too large to be listed; among emblematic species, vegetal found in basic rocks quarries include endangered ferns, such as *Polystichum lonchitis* (Walloon IUCN status: CR), and superior plants (e.g. *Alyssum alyssoides* (CR), *Pyrola rotundifolia* (VU), *Sedum sexangulare* (VU)) and a variety of endangered orchids such as *Ophrys* spp., *Anacamptis pyramidalis* (VU), *Dactylorhiza fuchsii* (VU), *Gymnadenia conopsea* (VU), *Orchis anthropophora* (VU) ...

Active limestone quarries often act as last refuges for rare species characteristic of oligotrophic and perturbed soils. In the Tournaisis area for example, quarry gravels are the last habitats of *Catapodium rigidum* (VU) and *Gnaphalium luteoalbum* (CR) and of *Ranunculus sceleratus* (DD), a characteristic of oligotrophic waters.

In quarry pits, the hard, oligotrophic waters resulting either from the aquifers or from the streaming waters form ponds adequate for the development of Stoneworts (*Chara* spp) and associated vegetation.

Bare gravel areas and screes left aside for a few months are rapidly colonized by rupicolous grasslands (*6110) and screes of hill and montane levels (8160) with rare species such as *Galeopsis angustifolium* (DD) and *Catapodium rigidum* (VU) but also by more common ones such as *Rumex scutatus*, *Chaenorhinum minus*, *Anagallis arvensis*, ... When left to natural recolonization they evolve slowly towards semi natural dry grasslands of the *Festuco-Brometalia* (6210) hosting a diverse flora highly affected in their original habitats by eutrophication and forest recolonization.

Without specific management, some areas can rapidly be colonized by invasive alien species such as *Buddleia davidii*, *Senecio inaequidens* and *Cotoneaster horizontalis*.

Zoological

A combination of factors such as recurrent perturbations and the oligotrophic status of the water but also the relative stillness of some areas leads to colonization by a diverse fauna. LIFE in Quarries targeted a series of umbrella species for amphibians, reptiles and birds that present an important potential for the development of populations in quarries.

Habitats Directive amphibians like *Bufo calamita* (Annex IV) and *Alytes obstetricans* (Annex IV) show largest populations in quarries pits; they take advantage of the constant involuntary creation of temporary ponds where few predators are present. In deeper ponds, *Triturus cristatus* (Annex II) can find the oligotrophic waters necessary for its reproduction. Other amphibians such as *Bufo bufo*, *Rana temporaria*, *Pelophylax kl. esculenta* and *P. lessonae* and all three other newts present in Wallonia take advantage of permanent ponds and lakes created during the exploitation process.

Habitats Directive reptiles frequently occurring in limestone quarries' dependencies (scree, sides of tracks, spoil heaps ...) south of the Sambre and Meuse valley (continental biogeographical region) are *Coronella austriaca* (Annex IV) and *Podarcis muralis* (Annex IV). They both take advantage of the open vegetation present in the quarries for their whole life cycle. The presence of the regionally protected species *Natrix natrix* is also frequent around more permanent ponds and lakes.

Rock quarries act as an adequate substitution habitat to host large populations of three priority Birds Directive species: *Riparia riparia* (Article 4.2), *Bubo bubo* (Annex I) and *Falco peregrinus* (Annex I).

Non-targeted species of the following groups are identified as potential beneficiaries of actions:

- Orthopters such as the regionally protected *Oedipoda caerulea*, whose Walloon populations are mostly found on extractive sites; a variety of solitary bees, such as *Anthidium oblongatum* and Coleopters of the genus *Cicindela* taking advantage of loose, sandy cliffs;
- Large diversity of dragonflies reproduces in temporary or more permanent ponds;
- Butterflies such as *Lasiommata megera* and *Polyommatus spp.* taking advantage of sunny habitats and of surrounding floristic resources;
- Chiropters are also taking advantage of old installation to rest or hibernate.

IV.1.5. Main conservation issue

Through their daily activities, quarries disrupt their environment creating refuge habitats for a set of pioneer species. LIFE in Quarries aimed at ensuring the permanent availability of habitat resources during the critical periods of species life cycles by implementing temporary nature management plans and good practices in the daily activities of the quarry.

Implementation of temporary management plans on industrial site can face legal constraints. The LIFE in Quarries aimed at analyzing the current legislation and ways of derogations to find solutions to facilitate the development of habitats of interest hosting protected species.

The opportunistic characteristic of pioneer species would then allow them to recolonize newly created habitats from the refuge areas. As such, quarries could act as stepping stones and complete the Green Infrastructure by connecting the Natura 2000 network for pioneer species.

The lack of knowledge and awareness on quarries' biodiversity management and its consequences are recurrent lock-in to an adapted management of biodiversity. Too often, quarry managers are not aware of the diversity of habitats they can create while the public usually sees quarries as biodiversity cankers. Communication actions of the LIFE in Quarries tried to raise awareness of the different stakeholders to maximize the biological and ecosystem services (ES) potential of active quarries.

IV.1.7. Socioeconomic context

Reconciling ecological concerns and socioeconomic priorities is a challenging task in a complex context of environmental and socioeconomic realities. The LIFE in Quarries aimed at demonstrating that operational solutions for biodiversity can be proposed and implemented through limited investments benefiting both stakeholders interested in nature and the private sector. Through a private-public partnership, the project intended to impact positively the local economy.

Moreover, with ecosystem services restoration efficiency in the post-exploitation phases as a target of the project, it targeted a positive contribution to the wellbeing of local populations by increasing regulating (air quality, water retention, pollination, carbon sequestration, ...) and cultural services (pleasant living environment for residents and promoting public access as green spaces for leisure activities or protected areas for nature discovery).

IV.2. Expected longer term results

The LIFE in Quarries developed actions to enhance ecosystems (by promoting restoration, maintenance and management of fugitive species and pioneer habitats in the exploitation phase and by maximizing stable and biodiversity-rich ecosystems in the post-exploitation) and their services (by preparing infrastructures, during exploitation processes to facilitate the establishment of restoration plans that will increase ecosystem services).

The long-term sustainability of the project's concrete actions aimed at developing the adoption of specific individual charters and biodiversity management plans integrating the recommendations and best practices of the project.

These individual biodiversity management plans will allow the implementation of dynamic management of habitats of protected species during the exploitation phase of quarries but also to restore permanent habitat during the extraction phase. The initially expected conservation objectives are presented here above (section IV.1.1.a - Expected results).

Knowledge will be transferred to other stakeholders (sectors, federations, companies, associations, administrations), both in Belgium and other EU countries, to apply the concept of dynamic biodiversity management.

Tools developed to facilitate this transfer: methodological guide focusing on the creation and dynamic management of temporary habitats in active quarries, description of the LIFE in Quarries implementation process, standard charter, and biodiversity management plan with guidelines, ... are ready to be used by stakeholders willing to engage. Associated partners have developed an expertise that will be made available to quarries over the long term.

A continued implementation concrete conservation actions, monitoring and the dissemination in the After-LIFE (F.3) will allow for the project to live on.

V. Administrative part

V.1. Project Management system

FEDIEX, the Belgian federation of the extractive industry, is the coordinating beneficiary of the project. The project coordinator was responsible for the general, administrative, and financial management of the project, the team management and supervision, the communication with partners, stakeholders, and the European Commission.

V.1.1. Project partnerships

Within the global partnership of the project, distinction is made between the associated beneficiaries of the LIFE team and the quarry partners affiliated to the coordinating beneficiary, i.e., extractive companies involved in the LIFE in Quarries project.

Associated beneficiaries

Led by FEDIEX, the LIFE in Quarries partnership has included the Walloon region (Department of Nature and Forests and Department of Natural and Agricultural Environment Studies), co-financing the project, and the University of Liège – Gembloux Agro-Bio Tech, Natagora and Parc naturel des Plaines de l'Escaut, as associated beneficiaries.

Partnership agreements were signed between the coordinating beneficiary and each associated beneficiary. Those agreements defined: (1) the role of the coordinating beneficiary and each associated beneficiary; (2) their responsibilities and the means to carry out the tasks foreseen in the Grant Agreement; and, (3) the payment phases.

Affiliated quarry partners

As described in section V.3, an amendment procedure regularized the situation of the extractive companies participating in the project. All 18 companies, representing 27 quarries, were committed as affiliated entities to the coordinating beneficiary, FEDIEX. Moreover, internal operating rules were established with the participating companies in terms of: (1) commitments (reporting, communication, sustainability of biodiversity benefits); (2) distribution of project resources; (3) access agreement to quarry sites; and, (4) modalities in case of non-compliance.

V.1.2. Human resources and organization charts

The organization of the project has been designed with an involvement of human resources from each beneficiary at two levels: the operational team and the coordinating team for the follow-up of the project.

Coordination committees and working groups

Different committees and working groups were set up for the coordination and follow-up of the project. The human resources composing these committees were working on personal contribution of the beneficiaries. The composition, role and meeting frequency of the committees are illustrated in Figure 2.

Monitoring Committee (Walloon region)

As stated in the ministerial decree (n°33.11/CH/Life Carrière/2015; visa 15/22360), the Walloon authorities, co-financer of the project, initiated two meetings of the monitoring committee per year to ensure strict compliance with the requirements imposed by both the EU Commission and the Walloon region. Through the EC reports and the RW intermediate reports, the committee ensured follow-up on the coordination, administration, and progress of the project.

This committee was composed of representatives from the DNF, the DEMNA, FEDIEX and ULiège-GxABT.

Steering Committee

An internal steering committee met at least twice a year to coordinate, to follow and to advise the LIFE in Quarries operational team. It was composed of representatives of FEDiEX, ULiège-GxABT, Natagora and PNPE.

Scientific Committee

This group was set to follow-up and to counsel on the scientific aspects of the project. Its role was to keep a general overview on the progress of conservation actions and to validate the scientific decisions. It was originally planned to meet at least three times a year and was composed of representatives of the DEMNA, ULiège-GxABT, Natagora, PNPE and FEDiEX. In practice, this committee only met a limited number of times at the beginning of the project then decided that it was not needed anymore as such and replaced by meetings between partners and direct bilateral exchanges with the DEMNA. The DEMNA being otherwise involved in the Steering committee had others opportunities to exchange with the project.

GT – LIFE

This working group gathered representatives of all extractive companies involved in the project. With at least two meetings per year, the GT-LIFE was set to coordinate the project with the quarry operators and validate decisions. At each meeting, the coordinator gave an update of the overall progress of the project. This working group included FEDiEX, and representatives of all extractive companies involved in the project. For the last year and a half of the project, it was decided to take advantage of the quarterly meetings of the environment committee of FEDiEX for this purpose. This committee was composed of representatives of all extractive companies (involved in the project or not).

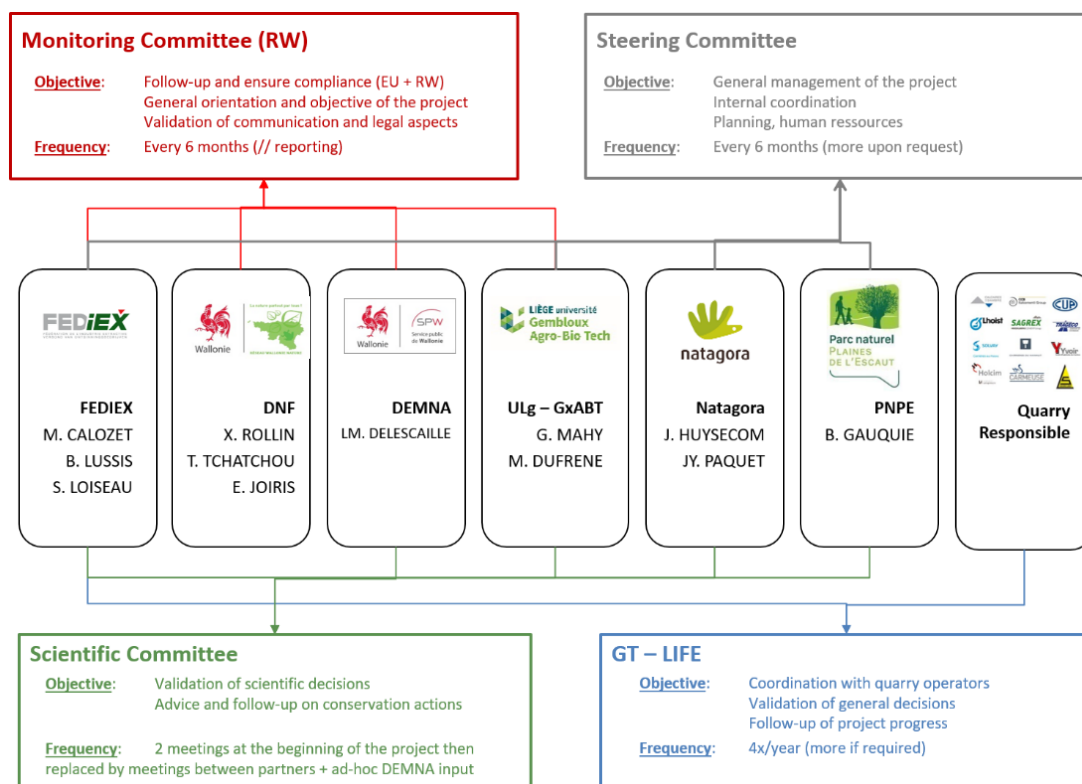


Figure 2. LIFE in Quarries Coordination Chart.

Operational team

The operational team of the project relied on human resources distributed amongst the different beneficiaries according to the organigram presented in Figure 3.

FEDIEX

Alexandre Sneessens was hired by FEDIEX as project coordinator. Victor de Neve took over from September 2020. Benoit Lussis, environmental advisor at FEDIEX, supported part-time the implementation of the project. Sébastien Loiseau took over his position in May 2018. Myriam De Marrez, HR coordinator at FEDIEX, helped part time as administrative support. Nicolas Hoffait was hired as administration officer to support part-time the project. Céline Druetz took over as administration and communication officer to support part-time the project as well and boost communication actions.

ULiège-GxABT

Maxime Séleck worked on the project as scientific coordinator for ULiège-GxABT with a broad involvement over most actions of the project. As successive Ecosystem services and Consciousness scientific coordinators, Laura Maebe, Kathleen Mercken, Vladimir Joassin (for D.6) and Lilly Gillet (for D.3) evaluated and monitored ecosystem services and sector’s consciousness (A.6, D.3, D.6). They also supported on specific tasks such as trainings and development of factsheets (E.5), redaction of action plans (A.3), onsite implementation of actions (C.1/C.2/C.3/C.4) and monitoring of tests (D.1). Sylvain Boisson ran the development of the AMBREs Platform (D.4). Lilly Gillet subsequently supported in this task. Mélanie Harzé and Julie Lebeau provided a short input as help in trainings (E.5) and action plans (A.3) and 5 students were implied in concrete conservation actions (C.3) and helped in monitoring (D.2). Students were also regularly involved in supporting tasks of D. actions under Master Thesis.

Natagora

Natagora was responsible for the implementation of biological surveys (actions A.3, D.2) and the support of implementation of workshops, training and dissemination (A.1, A.2, C.1-C.4, D.1, D.4, D.5, E.5, E.6, E.8). Natagora’s team was composed of naturalist experts under the coordination of Julien Taymans. Main experts were Pascal Hauteclair, Marie Vanschepdael, and Thierry Kinet. They were supported by punctual interventions of other colleagues and internal resources.

PNPE

Benoit Gauquie and Charlotte Mathelart worked on the project with equivalent inputs as those of Natagora restricted to the Hainaut province and to transversal actions. They were supported by punctual interventions of internal resources.

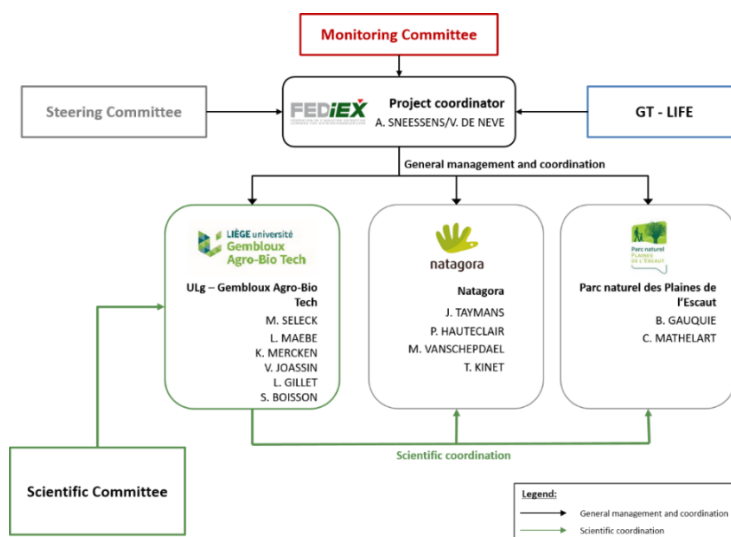


Figure 3. Organigram of LIFE in Quarries operational team.

V.2. Communication with the Agency and Monitoring team

The project coordinator was in regular contact with the monitoring team (Thomas Wouters then An Bollen from 2020 onwards) for any operational question or problem. Exchange of information was done by regular e-mail or phone contacts, annual visits, and progress reports in a truly collaborative and constructive way.

The specific context of the LIFE in Quarries project required clear indications, collection of documents not being straightforward as involved 18 private companies showing very diverse structures from family-owned with a few employees, to multinational companies with complex management systems.

V.3. Amendments to the Grant Agreement

V.3.1. Amendment #1 (approved on 06/12/2016)

As requested by EASME, amendment #1 modified the obligation to information, threshold for submission of audit certificate, and submission of reports.

V.3.2. Amendment #2 (approved on 27/11/2017)

The coordinating beneficiary, FEDIEX, is legally defined as a private non-commercial association with member companies having an independent legal status. As member companies of FEDIEX had an active role in the implementation and contributed to the budget of the project LIFE in Quarries, all participating companies were engaged as affiliated entities to the coordinating beneficiary.

The participating quarries were actively involved in the implementation of the concrete conservation actions (C.2, C.3, C.4) on their sites with their own personnel, machines, and production materials.

Amendment #2 regularized 3 points:

1. Replacement of Phase I quarry of Marche-les-Dames by Dumont-Wautier/Hermalle. This change was asked by the mother company Lhoist due to temporary shortage of human resources in the initial site. Marche-les-Dames participated to the 2nd phase of the project;
2. Addition of 2 sandstone quarries to phase I (Yvoir/SECY and Steinbach/Trageco), bringing the total to 14 sites. The main reason for the implication of these 2 sites in phase I, instead of the second phase of the project, was to:
 - Reinforce the capabilities to meet the objectives C.2/C.3, as the actions were thus distributed among 14 quarries for the first phase of the project;
 - Increase the representativity of sandstone quarries;
 - Increase the distribution of participating quarries in the Walloon region;
 - Respond to the large enthusiasm of the sector encountered for the project, maximizing as such our communication objectives;
 - Face the prospect of a participating quarry quitting the project for an exceptional reason.
3. Administrative clarification of involvement of the quarry companies participating in the project with the adequate status of affiliates in line with the general conditions of the Grant Agreement. This operation included:
 - Administrative steps, e.g., declaration of affiliation, legal entity files;
 - Revision of the financial forms: Personnel, External assistance and Consumables costs were allocated to the different affiliates. The initial estimations were still considered viable so that the global budget of the project has not been impacted by the amendment.

These modifications did not complicate the project structure and did not have any negative impact on the technical and financial coherence of the project. The scope of the project was not altered by these changes. However, the administrative burden weighed on the first implementation stages of the project.

V.3.3. Amendment #3 (approved on 16/08/2018)

As requested by EASME, amendment #3 modified the definition of conditions for natural persons, submission of VAT certificate and threshold for submission of the certificate on the financial statements.

V.3.4. Amendment #4 (approved on 20/04/2020)

Amendment #4 approved a 12-month extension of the project duration.

Timing deviations, mainly due to the complexity of the project, motivated the partners to request such an extension to adequately finalize the project. The opportunity was seized, for the following complementary purposes:

- Addition of 1 quarry to phase II (Haut-le-Wastia/Colas): This helped to meet the C objectives, increase the level of dissemination, respond to the large enthusiasm of the sector, and face the eventuality of a participating quarry quitting the project for an exceptional reason;
- Validation of budget transfers, e.g., the reinforcement of administrative and communication support at FEDIEX and the development of an online monitoring platform at ULiège-GxABT (under D.4).

V.3.5. Amendment #5 (approved on 21/09/2021)

Amendment #5 approved a 3-month extension of the project duration, linked to Covid-19 related delays.

This also offered the opportunity to regularize the withdrawal of the affiliate Mettet (SIBELCO) that had ceased operations and which expenditures were all own contribution (no EU funding) and therefore remained included in the own contribution of the coordinating beneficiary (FEDIEX).

The scope of the project was not altered, since 3 additional quarries joined the project and hence the target of participating quarries as set out in the Grant Agreement could be reached/surpassed.

VI. Technical part

VI.1. Technical progress, per Action

VI.1.A Action A - Preparatory actions

A.1 Assessment of the state of the art on temporary nature management

Foreseen start date: October 2015

Actual start date: October 2015

Foreseen end date: March 2016

Actual end date: September 2016

Action A.1 aimed at establishing a state of the art on the management of temporary nature through a literature review (A.1a), by ULiège-GxABT with support from Natagora and PNPE, and at organizing an initial workshop conference (A.1b), by FEDIEX with support from other partners.

a. State of the art on temporary nature management

Sub-action A.1a led to a provisional report on the state of the art on temporary nature management¹. This review consisted in compilation of scientific and grey literatures on temporary nature management. It strived to further develop and bring details about the proposed actions supporting the implementation of tests (C.1) and concrete conservation actions (C.2). Notably, it led to the addition of sand banks as an alternative to vertical faces (under sub-actions C.1c and C.2c) and of Common gull platforms and islets as alternatives to Tern platforms (under sub-actions C.3c).

Throughout the project, the document was implemented throughout action C.1 to C.4 and, following test and biological monitoring actions D.1 and D.2 led to action E.5c deliverable Methodological document on temporary habitat's creation and maintenance.

Technical problems: While some sub-actions are well documented and have previously been implemented (C.2a, C.2b, C.2c, C.2e), the review led to conclude that active screes (action C.2d) implementation could not go further due to security concerns linked. It was then confirmed from interactions with sites' managers that working on active screes could not be allowed by quarries due to safety reasons.

b. Initial workshop

The initial workshop was held on the 4th of May 2016 in Brussels with an audience of 85 persons. The presentation were given by a diversity of 19 international speakers.

Technical delays: The slight postponement of the workshop was linked to the merging of the LIFE in Quarries workshop with a similar event planned by SIBELCO (international extractive company member of FEDIEX). This delay was motivated by the collaboration helping increase the audience of the workshop and the visibility of the project in Belgium and at an EU level. This planning shift was communicated prior to the event and agreed by EASME (Letter #1 – Ref. Ares(2016)2653985).

1

A.2 Setting up of a set of indicators

Foreseen start date: October 2015

Actual start date: October 2016

Foreseen end date: October 2015

Actual end date: September 2018

Action A.2 aimed at developing sets of indicators to monitor the project's actions. The list evolved over the implementation of the project. Indicators were developed by ULiège-GxABT along with Natagora and PNPE for sub-action A.2b and with FEDIEX for sub-actions A.2d and A.2e.

a. **Pilot actions indicators (for Actions C.1 - D.1)**

Simple indicators allowing determining the success or failure of pilot actions C.1 were defined. They resulted from the outcomes of sub-action A.1a adjusted to the true potential of C.1 realizations monitored in D.1.

b. **Biological indicators (for Actions A.3 - C.2/C.3 - D.2)**

A list of indicators aimed at evaluating the biological stakes. It was defined in 2016 along with inventories protocols (under action A.3). The initial list first evolved after the realization of inventories (action A.3a) and following the implementation of the 2018 and 2020 Phase I monitoring (action D.2). While they continuously targeted the main biological groups at stakes, i.e., birds, amphibians, reptiles, insects/dragonflies, vascular plants (including patrimonial species), the final round of reviews (as part of action D.2) allowed fitting to a sound resolution level adapted to 14 sites with: (i) a large diversity of groups; and, (ii) populations of target species monitored naturally fluctuating. The review allowed integrating project's goals and specifically monitor impacts of C.2/C.3 actions on target species.

c. **Ecosystem services indicators (for Action A.6 - D.3)**

A list of ecosystem services (ES) indicators relevant to quarries was established based on the Wal-ES (Walloon platform on ecosystem services) and a literature review. These indicators were developed in accordance with action A.6 and implemented in action D.3: first at sites then at project's level.

d. **Basic monitoring indicators (for Action C.1 to C.4a - D.4)**

A tentative set of basic biological and/or management indicators – simple and synthetic – was integrated in September 2018 for an appropriation of a basic monitoring by quarry personnel. These indicators were defined in accordance with outcomes of a ULiège-GxABT students' work aimed at proposing an indicator framework constructed along with quarries' environmental managers interviews.

As the overall objective was to end up with a coherent set of indicators operational for the After-LIFE monitoring and adapted to quarry personnel knowledge, the set was first tested in the framework of action D.4 then further evolved with the development of the AMBREs platform (as part of action D.4) and management plans (action D.5).

Information and exercises were provided to quarry personnel under AMBREs platform training sessions (action E.5a). The indicators will further be implemented in the After-LIFE (F.3) thanks to the AMBREs platform as planned in D.5 management plans.

e. **Socio-cultural and cost of biodiversity management indicators (for Action D.6)**

Indicators to assess and monitor the sector's biodiversity awareness were developed for actions D.6a & b.

This list was completed upon redaction of action D.6c's report with indicators allowing the evaluation of time spent in the development of (temporary) nature on sites. Indicators consisted in time*men or time*machines and in quantities of materials and expertise required, allowing a quarry to evaluate an implementation cost for the whole LIFE in Quarries framework in accordance to its own costs. Indicators were categorized as:

- Technical means, i.e. machines;
- Humans means, i.e. Quarry's personnel time;
- Financial means, i.e. expertise and materials.

Technical delays were linked to indicators' updates along with their implementation. They did not affect the project's action but rather helped integrate its natural evolution. Final revisions were undertaken under the corresponding D.-monitoring actions.

A.3 Inventory and mapping of the main stakes

Foreseen start date: January 2016
Foreseen end date: December 2019

Actual start date: January 2016
Actual end date: April 2020

Biological inventories (A.3a), realized by Natagora, PNPE and ULiège-GxABT, aimed at orienting actions to set in place and at defining the initial situation of biodiversity in a monitoring perspective (D.2). They lead to the definition - by all partners under the supervision of ULiège-GxABT - of 27 action plans serving as road maps for the implementation of C.2 to C.4a concrete conservation actions.

a. **Biological inventories**

Protocols for inventories and monitoring first defined in 2016 and were subsequently adjusted (under action D.2) following the implementation of the 2018 and 2020 biological monitoring. The final version of the protocols² took into consideration the revisions of indicators from sub-action A.2b.

Habitats' mapping following the WalEunis typology was realized along with standardized inventories of main biological groups relevant to quarries biodiversity: Flora, Amphibians, Reptiles, Odonata (dragonflies and damselflies) and Birds in the 27 quarries of the project (see Figure 1 and Table 1). All biological data were recorded on the regional official biological platform OFFH³ representing 41 269 data (with 32 989 additional data linked to monitoring action D.2).

Inventories were undertaken in three phases:

- 14 Phase I quarries were inventoried in 2016;
- 10 Phase II.1 quarries were inventoried in 2017, a timing optimized to maximize time available for C.4 actions implementation;
- 3 Phase II.2 quarries were inventoried in 2019;

Sub-action a resulted in 27 individual inventories reports establishing, for each quarry, a baseline of biological stakes with inventories, context and habitats' maps. Reports were redacted by Natagora and PNPE with post-treatment of data, the initial development of a common canvass and coherence between partners were insured by ULiège-GxABT base on implementation on a test site.

A synthetic report was developed by ULiège-GxABT in partnership with Natagora and PNPE. It integrated the outcomes at the project's level, first for the 14 Phase I quarries and updated for the 24 Phase I and Phase II.1 quarries. Phase II.2 sites were not integrated as not planned in the process. An anonymized version of the final report was made available online allowing the sharing to a broader audience⁴.

Globally, the **mapping** allowed revealing the relative importance of the different biotopes encountered on the 3057 ha inventoried:

- Following built biotopes (38.2%), dominated by fully active areas of quarries offices and industrial sites, forests and plantations represented 22.3 % of inventoried surfaces. Grasslands and swards represented 16.4% of the vegetation including 9.9% of ruderal vegetation;
- Though they do not represent significant areas, aquatic habitats (3.7%) and semi-natural – reconstructed or in place – grasslands and swards (6.5%) consist in key elements of sites' biodiversity;
- In addition, a high percentage of quarries active area comprised within the “built” biotopes, do not exclude the development of actions within the 34.23% of “active quarry” biotope (Wal-Eunis J3.2) and the 0.21% of “highly artificial aquatic habitats” (Wal-Eunis J5).

² Available at <http://hdl.handle.net/2268/260795>

³ <http://observatoire.biodiversite.wallonie.be/encodage/>

⁴ Available at <https://hdl.handle.net/2268/235590>

The target **biological groups** were well represented in surveys with:

- 815 species flora among which 115 of the patrimonial flora from which groups reflect sites' abiotic conditions;
- 12 out of 13 species of Walloon Amphibians, among which 10 populations of the Natterjack toad (*Bufo calamita*), 4 populations of the Great crested newt (*Triturus cristatus*) and 15 populations of the Midwife toad (*Alytes obstetricans*);
- Six out of seven species of Walloon Reptiles among which 7 populations of the Smooth snake (*Coronella austriaca*), 11 populations of the Common wall lizard (*Podarcis muralis*) and 1 population of the Sand lizard (*Lacerta agilis*);
- 38 out of 64 species of dragonflies and damselflies among which 11 species are considered as patrimonial, three being target species of the project observed on 8 to 12 sites;
- 113 species of breeding birds among 13 concerned by the Birds Directive (79/409) and set as Annex XI and XIb of the Walloon *Loi sur La Conservation de la Nature*⁵.

High occurrences of other amphibians and reptiles species encountered on sites lead the project's team to include both groups as a whole in biological targets. Though not always included in Habitats Directive annexes, most species are indeed threatened at the regional scale and can benefit from large populations installed in and/or promoted in quarries.

It is to be noted that these numbers evolved throughout the project with new populations, in particular of small and/or cryptic species, encountered and allowing to update the lists taken into consideration in final management plans (under action D.5).

An intern student (Luca Covone) from the University of Liège realized a **global study of amphibians' translocation potential** within the project's sites in close relationship with amphibians experts of Natagora, ULiège-GxABT and PNPE. The analysis evaluated IUCN criteria in order to assess the suitability for all three amphibians introductions in the 24 Phase I and Phase II.1 quarries (quarries of Phase II.2 were not known then).

Specific criteria were developed for 4 species of amphibians on biological and habitats' requirements:

- Natterjack toad – *Bufo calamita*;
- Great crested newt – *Triturus cristatus*;
- Yellow bellied toad - *Bombina variegata*;
- Midwife toad - *Alytes obstetricans* (complementary action).

As such, the study resulted in a list of quarries where translocations of amphibians were evaluated as relevant. The scientific report was the main support for derogation requests introduced to: (i) first study the source populations; and then, (ii) collect and transfer eggs/tadpoles/individuals (or breed them in the case of Yellow-bellied toad).

b. Management plans

(note: further called "action plans" as "management plans" were part of action D.5)

Following inventories of each site, meetings to define **biological priorities for actions**, were organized with project partners under the scientific supervision of ULiège-GxABT. They aimed at:

- Validating biological inventories;
- Defining priorities for actions in terms of species and habitats, taking into consideration outcomes of Ecosystem Services evaluations and guidance (action A.6);
- Defining objectives for the development and/or management of target and patrimonial species on sites as well as opportunities for flora (sub-action C.2f) and amphibians translocations (sub-actions C.2g, h, i and related in C.4);

⁵ <http://environnement.wallonie.be/legis/consnat/cons001.htm>

- Defining objectives for (analog) habitats restorations and/or C.2 to C.4 concrete conservation actions;
- Mapping these initial propositions.

The team then presented the outcomes in 27 meetings taking place in participating quarries. Meetings allowed **confronting propositions to exploitation plans** with quarry managers and/or environmental responsible:

- To clarify some actions a tour of the quarry was organized;
- Within the propositions, the LIFE in Quarries team solicited managers to maintain only realistic actions that could be initiated within the project's timeframe and counter-propose others.
- The propositions were then confronted with the requirements of the quarries authorizations resulting from the legal analysis in action A.4 as well as from direct exchanged with quarry/environmental managers;
- Agreements in principle from the quarry resulted in 27 final, validated action plans and 27 synthetic maps as road maps for actions.

Once the action plans were accepted, the partner in charge of the quarry's support along with the quarry personnel elaborated a yearly planning for the implementation of actions C.2 to C.4a. This planning was regularly reviewed/adapted under action D.5 and following implementation of actions. Remaining actions from the action plans that could not be implemented during the project are expected to continue as road maps for the years to come under the After-LIFE (action F.3).

The process led to the identification of a broad potential for implementation. Updated numbers including the 3 Phase II.1 sites are presented in Table 2 and Table 3. The true potential for sub-action C.2f were defined upon production of seeds without limits resulting from quarries presented under sub-action C.2f.

Table 2. Potential for C.2 sub-actions (and equivalent in C.4) identified after definition of action plans in action A.3.

	C.2a Pioneer ponds (n)	C.2b Pioneer grasslands (ha)	C.2c Vertical faces for Sand Martins (n)	C.2c Sand banks for solitary bees (n)	C.2d Dynamic screes (ha)	C.2e Shelters (n)	C.2g Natterjack toad translocation (n)	C.2h Great crested newt translocation (n)	C.2i Yellow-bellied toad reintroduction (n)
Objectives LIFE in Quarries	120	12.0	10	/	5.0	96	4	4	1
Phase I (14 sites)	349	31.7	6	6	-	304	3	6	-
Phase II.1 (10 sites)	434	26.9	12	18	-	254	2	3	1
Phase II.2 (3 sites)	54	6.9	-	1	-	72	-	-	-
	837	65.5	18	25	0.0	630	5	9	1

Table 3. Potential for C.3 sub-actions (and equivalent in C.4) identified after definition of action plans in action A.3.

	C.3a Permanent ponds (n)	C.3b Inear of bank favourable to reedbeds (m)	C.3c Terns platforms (n)	C.3c Common gull platforms (n)	C.3c Islet (n)	C.3d Chiropters galleries (n)	C.3e Mowed grasslands (ha)	C.3f Grazed grasslands (ha)	C.3g Last blasting (m)	C.3h Linear screes (m)
Objectives LIFE in Quarries	24	400	16	/	/	4	10.0	50.0	200	8000
Phase I (14 sites)	116	125.0	6	5	3	15	25.4	50.7	217	4656.9
Phase II.1 (10 sites)	92	395.0	2	7	-	6	17.8	54.9	-	3332.5
Phase II.2 (3 sites)	9	-	2	-	-	2	1.4	-	-	202.0
	217	520	10	12	3	23	44.6	99.6	217	8191.4

Technical delays for the 14 first (Phase I) were linked to the process of validation of action plans that revealed time consuming in link with the complex structure of some of the participating quarries and their will to only validate actions that would fit into budgets and human resources. A smoothed procedure allowed for faster implementation in Phase II quarries with delays limited to a few cases. These delays somehow affected the launching of the C.2 to C.4a actions without jeopardizing commitments.

A.4 Analysis of the legal framework

Foreseen start date: January 2016
Foreseen end date: September 2020

Actual start date: January 2016
Actual end date: December 2021

a. **Legal analysis of the interpretation of the temporary nature concept**

A legal analysis performed by SERES-UCL. included several tasks:

- An analysis of the Walloon legislation related to the protection of species and habitats – mainly an analysis of the Nature Conservation Law – articles 2bis, 3, 3bis and 5 – which partially transposed the Birds and Habitats directives;
- A comparative study of existing legislation in other countries or regions, including Flanders, The Netherlands, Germany, France, UK, Sweden, Switzerland, USA. This was performed by submitting a questionnaire sent to legal experts in the considered countries;
- An analysis of the Birds and Habitats directives.

The report:

- Identified the potential problems in implementing dynamic management actions regarding the provisions of the Birds and Habitats directives and their implementation in the considered countries;
- Proposed some potential legal and regulatory solutions or perspectives to solve these problems.

b. **Legal support to participating quarries**

The analysis of the compatibility of actions with requirements of the quarry authorizations was performed by Maître Pierre Moërynck for Phase I and II.1 quarries. It resulted in the delivery of individual sheets summarizing focal points potentially conflicting with action plans and quarries' authorizations.

The legal review of the permits showed that both the quarries' authorizations and the LIFE in Quarries action plans could be imprecise or vague in terms of obligations, location, etc. Hence, the deliverables of the analysis, i.e., individual comparative sheets, were considered as focus points and were supplemented with operational point of view of the quarry operators when implementing concrete conservation actions.

As presented to NEEMO on 28/05/2020 (virtual visit), this legal analysis was solely carried out in consultation with quarry operators for the 3 phase II.2 quarries and it revealed no significant conflict/issue with temporary nature management hence the synthesis report on the support actions and adopted solutions was replaced by a compilation of individual sheets.

c. **Support to the redaction of the charters**

The legal analysis (action A.4a) is the backbone for the After-LIFE plan. The lawyer in charge, Pierre Moërynck, worked on two documents:

- Administrative circular

The legal study concluded it is possible to reconcile a more dynamic approach towards nature management at quarry site-level with the relatively strict protection requirements.

As the context is new in the Walloon region, the administrative circular helped the regional administration for the delivery of derogations with a plan-based approach. It is argued that an adequate management of pioneer species/habitats is in the interest of protecting wild flora and fauna and conserving habitats.

To do so, the biodiversity management plan of each quarry (resulting from action D.5a) ensures an adequate implementation of concrete actions achieving favorable conservation measures for target species/habitats.

- Commitment charters

Individual charters were signed between the participating quarries and the Walloon region to ensure the sustainability of the actions during at least 15 years. By the means of charters, the quarry operators commit themselves towards the authorities.

The 15 years duration is commonly accepted by regional authorities and nature conservation associations and inspired by the EU rural development program 2014-2020 implemented in Wallonia where funds are available, under M7.6, for restoration works for habitats of community interest. Charters refer to the individual biodiversity management plans (resulting from action D.5a).

A.5 Construction of a quarry network

Foreseen start date: October 2015

Actual start date: October 2015

Foreseen end date: October 2019

Actual end date: October 2020

The objective of this preliminary action was the identification of stakeholders to ensure successful dissemination actions towards adequate audience. Based on this audience, an active diffusion of the project's objectives and progress was undertaken by the beneficiaries from the early project through actions E.

3 databases were elaborated and regularly updated, for the 3 diffusion targets previously identified (total number of contacts amounted to 552):

a. Quarry members of FEDIEX

The voluntary implication of participating quarries means that the success of the project is depending on the receptivity of the sector. As such, active promotion of the project to quarry members is crucial for the project sustainability. The database developed for this sub-action consisted in a list of CEOs and quarry managers from the Belgian extractive industry.

Successful dissemination to an adequate audience was shown by the positive enthusiasm of the sector to join, as demonstrated by the number of quarries that joined the project.

b. Increased public awareness

Beyond its member companies, the quarry sector collaborates with many other stakeholders. This audience was a key for a successful dissemination and hence an increased public awareness.

This list was based on FEDIEX contacts and regularly updated with contacts made during dissemination actions.

c. Dissemination at European level

European communication is crucial for a large dissemination of project progress and outcomes. The database developed for this target was initially based on the FEDIEX connections with extractive federations at EU level, other national federations, and international quarry companies. This contact list was regularly updated and served for multiple E. actions.

Indicators

- Number of FEDIEX quarries integrated in the diffusion list: 57;
- Number of contacts in the broad audience database:
 - Administration, Walloon region (DNF / DEMNA): 61;
 - Administration, Flanders region: 56;
 - Other stakeholders, Walloon region: 55;
 - Other stakeholders, other regions: 65;
- Number of organizations in the diffusion list for the dissemination at the EU level: 66.

A.6 Evaluation of the ES significance of quarries in the landscape

Foreseen start date: April 2016

Actual start date: November 2015

Foreseen end date: October 2018

Actual end date: January 2021

The evaluation of Ecosystem services (ES) aimed at evaluating ES status in quarries at the beginning of the project to define a zero-state value and allow understanding the potential trade-offs in the orientations of actions. It further aimed at orienting management to insure ES maximization under actions C.2 to C.4a.

An initial work consisted in proposing a methodology for the evaluation of ES in active quarries. This methodology was based on the work from the Wal-ES platform completed by a literature review. The methodology developed, by evaluating a diversity of values for a service (monetary, qualitative or surfaces), aimed at limiting the bias and at allowing for comparisons.

ES are classified in 3 categories:

- **Provisioning services**, i.e., Products obtained from ecosystems;
- **Regulation services**, i.e., Contributions from regulation of ecosystem processes;
- **Cultural services**, i.e., Nonmaterial contributions from ecosystems;

The LIFE in Quarries methodology to evaluate ES in Quarries assumed their 'value pluralism'. The approach adopted in the project was based on three assessment dimensions to consider the diversity of the components that link ecological structures and processes to human well-being as well as the beneficiaries of ES:

- **Biophysical** (e.g., volume, weight, area, etc.);
- **Social** (e.g. qualitative importance, perception, etc.);
- **Economic** (monetary value).

Such a multidimensional methodology enabled the development of indicators for the estimation of:

- **ES stock**: the potential of services supply provided by ecosystems;
- **ES flow**: the amount of ES that meets a demand;
- **ES demand**: demand for a service by individuals or a human community.

Within each ES category, services relevant to the quarrying industry were selected and the method to study them defined under action A.2c. A total of 63 ecosystem services: 26 Provisioning, 21 Regulating and 16 Cultural services; were selected based on (i) Ecosystems present in quarries; (ii) Literature on ES in quarries; (iii) Activities carried out in the quarries; and, (iv) Potential influences of the project actions.

They were then evaluated through a diversity of means (mapping, literature, surveys, and valuation of natural products ...) for all quarries in three phases:

- Evaluations for the 14 Phase I quarries were completed in December 2016;
- Evaluations for the 10 Phase II.1 quarries were completed in June 2019;
- Evaluations for the 3 Phase II.2 quarries were completed in January 2021.

Results were presented in 27 sheets (1 per quarry) summarizing all ES evaluated.

The evaluation allowed understanding economic, ecological, social and cultural importance of quarries, to:

- Inform decisions for the elaboration of action plans (action A.3b) considering environmental impacts;
- Communicate more effectively on the values of the natural environment and its services (actions E);
- Improve ES provision in active quarries;
- Manage trade-offs and certain risks by transforming them into opportunities;
- Understand the impact of nature management actions on stakeholders.

The analysis of the ES initial situation guided action plans (A.3b) and the final Management plans (D.5) to positively impact provisioning, regulatory and cultural services. The initial status of the ES was expected to be compared for each quarry in action D.3 The intermediary evaluation led to rather compare the initial and the final/expected status at the project's level (see action D.3).

The methodology developed benefited from the attendance to the ESP Conference at Utrecht (Netherlands, May 2016). Outcomes were presented at three BEES XMAS markets on Ecosystem services (Brussels and Gand, Namur, Belgium – December 2015, 2016, and 2019), at the ES LIFE Platform (Tallinn, Estonia – May 2019), at an INTERLIFE (Soest, Netherlands – October 2018) and at the 8th World Conference on Ecological Restoration (SER - Cape Town, South Africa - September 2019). It was also communicated upon specific request from the LIFE Pays Mosan (LIFE13 NAT/BE/001067).

Technical delays for the overall action were linked to the fact that results of A.3a (habitat maps) as well as quarries' feedbacks - e.g., on sites' visits - were necessary for a detailed assessment and as it appeared that the 6 months period initially scheduled was too short to assess some ES such as cultural services. Consequently, the final report on the ES initial situation for the 14 Phase I quarries was finalized in December 2016. A delay was asked in progress report #1. This delay was accepted by EASME (ref. ARES(2017)2537987). For the same reasons, the finalization of 10 additional initial situations for Phase II quarries was finalized in June 2019. The 3 Phase II.2 quarries evaluation was further impacted by the Covid-19 crisis (limited availability of quarry managers for surveys at the beginning of 2020) and this led to a finalization of the action in January 2021. These delays did not significantly influence other actions as the general guidelines for each conservation actions of the project (C.2 to C.4a) were explained and understood early allowing informing propositions under sub-action A.3b.

VI.1.C Action C - Concrete conservation actions

C.1 Tests on the creation and maintenance of temporary habitats

Foreseen start date: January 2016

Actual start date: May 2016

Foreseen end date: October 2018

Actual end date: October 2018

Implementation of pilot actions aimed at testing the creation and maintenance of temporary habitats with the techniques identified through Action A.1 as well as of innovative sub-actions of permanent nature C.3b, C.3c and C.3g.

Tests were initiated in 2016 in 6 volunteer quarries of Phase I. To allow for a complete picture of the variety in sub-actions expected from action A.1, specific actions implemented at the early stages of actions plans were added to the C.1 package through 2018. This, in effect, lead to the inclusion of test actions on 8 new sites. A summary of realizations is summarized in Table 4. The details of actions undertaken in action C.1 and monitored under action D.1 is presented in the report *Synthetic report on biological value of pilot actions after 2 complete years* (see action D.1).

!!!Note that upon realizations, actions C.1 were integrated to outcomes of action C.2, C.3 and C.4 to allow reporting on total numbers, linear and surfaces of functional actions implemented over the project (see comment under C.2).

Table 4. Summary of implemented C.1 actions.

Sub-actions	Unit	Objective	Monts de Baileux	Bierghes	Calcaires de la Sambre	Lustin	Clypot	Carrières du Hainaut	Hermalle	Sablère Lannoy	Milieu	Les Petons	Steinbach	Trooz	Yvoir	Frasnes	Realisations	Progress
C.1a*	n	10			14(3)	6	16	15(7)		6		23(11)		1			81(21)	810%
C.1b	ha	1.00		0.07	0.48	0.34	0.37			0.15		0.61			0.41		2.42	242%
C.1c – Sand martins	n	1	1**					1		1**		2**				2	7**	700%
C.1c – Solitary bees	n	/			1					1	1						3	/
C.1d	ha	0.50															0	0%
C.1e	n	8			4	2			3			2	2				13	162.5%
C.1f*	n	4															5(9)	125%
C.1g	n	/															0	/
C.1h	n	/															0	/
C.1 – C3b	m	/										170					170	/
C.1 – C3c – Tern platform	n	/										2					2	/

*: Numbers in brackets correspond to numbers discarded at the end of the action D.1 monitoring period.

** : Numbers including spontaneous colonisations at Sablières Lannoy and Monts de Baileux and an additional vertical face in 2018 at Les Petons.

a. Tests of creation and management of temporary ponds

81 temporary ponds (Table 4) were dug in a variety of conditions in 7 different quarries under the supervision of ULiège-GxABT. This allowed to optimize methods allowing the maintenance of an adequate water level for target species and discard ineffective ones in perspective of sub-action C.2a and its equivalent in action C.4. Ponds creation were attached to three main categories depending on the different water sources: 27 accumulating **rainwater**, 36 in **run off** zones and 8 dug to reach **groundwater**.

The creations allowed testing for a broad range of conditions. As example, while ponds originally targeted shallow areas, some deeper ponds were also created. Similarly, surfaces were in a few cases higher than the 25m² threshold to the benefit of Natterjack toad (*Bufo calamita*). Expected to be preferentially implanted in sunny areas, some ponds were set in shaded areas to the benefit of Midwife toad (*Alytes obstetricans*) and Stoneworts (*Chara sp.*).



Figure 4. Test creation of temporary ponds at Lustin (left) and Carrières du Hainaut (right).

Tests of intra-site transfers of Stoneworts (*Chara sp.*) expected to facilitate colonization of new ponds by the target species/habitat were implemented within 18 ponds of 4 sites in 2018.

b. Tests of pioneer grasslands management (through transfers)

The extent of the sub-action was broadened to 2.42 ha of pioneer grasslands either consisting in:

- pre-existing patrimonial grasslands: **identified and set aside** (0.32 ha), **transferred** (0.41 ha), or **refreshed** (0.07 ha);
- new areas: **host substrates (0-20 cm deep) creation** (0.42 ha - Figure 5) or **refreshed from shrublands** (0.97 ha) and **sown** with a mix of common pioneer species;
- new areas: **refreshed from shrublands** and **sown** with a mix of messicolous species (0.23 ha).

This was followed, when evaluated as adequate, by the sowing of stonecrops fragments (*Sedum sp.*).

Due to unpracticality and feedback from EASME, the sowing of messicolous was not maintained in actions C.2 and C.4. As the creation of host substrates resulted time-consuming and expensive, it resulted unpractical and subsequently restricted to the creation of permanent nature areas under sub-actions C.3e or C.3f.



Figure 5. Creation of 'host substrate' in a pit area (Les Petons).

c. Tests of vertical faces creation and management

Sub-action C.1c was subdivided in two as a result of action A.1a:

1. 7 vertical faces (i.e., loose cliffs) were created for Sand martins :

- The refreshing of an existing sand stock was executed in Carrières du Hainaut;

- 4 new faces were created from sand stocks: 2 at Les Petons by providing whole sand stocks and two faces at Frasnes (Phase II.1) in collaboration with a local NGO “Les Bocages”. The pre-existing collaboration was encouraged as important towards post-LIFE management;
- 2 cases of spontaneous colonization also led to the maintenance of vertical faces: (i) as part of “business as usual” at Sablières Lannoy where a colony is known to occur since a few decades; (ii) as a result of the identification of a new colony installed in stocks at Monts de Baileux.



Figure 6. Vertical faces created at Carrières Les Petons (left) and refreshed at carrières du Hainaut (right) in 2016.

2. 3 sand banks benefiting solitary bees were tested:

- A sand bank serving both as protection of a pioneer grassland and benefiting solitary bees was set in place at Sablières Lannoy;
- A sandy slope colonized by shrubs was refreshed at Calcaires de la Sambre to favor bare surfaces expected to benefit solitary bees and other burrowing insects;
- Small faces were carved in the loose substrate of a slagheaps’ slope at Milieu.

In addition, the plantation of willow cuttings favoring food resources associated to the carving of small faces was tested at Milieu quarry by PNPE management team.



Figure 7. Refreshed slope at Calcaires de la Sambre.

d. Tests on scree creation and enrichment

As active screes were cancelled due to security concerns, the action was not tested.

e. Creation of shelters

This sub-action aimed at enhancing the hosting capacity of homogenized grounds of quarries. Installation of temporary diversified structures (stacking rocks, wood debris ...) serve as refuge for amphibians, reptiles or insects associated to temporary ponds and pioneer grasslands. They can also be set in spoil heaps/permanent areas as a mean of habitat diversification

During the test phase, 13 shelters were built:

- 4 ‘hibernacula’ consisting in buried rocks (20-40cm) shelters serving as winter refuges for amphibians and reptiles were created at Calcaires de la Sambre in association to pioneer ponds;
- 3 stony niches were set at the Hermalle – principle is similar to that of hibernacula but set in slopes;

- 4 rocky ‘day shelters’ consisting in rock piles of c. 1 m in height with a volume of 2 to 5 m³. of rocks ranging between 20 and 40 cm in diameter were built: 2 at Lustin and 2 at les Petons associated to pioneer ponds;
- 2 wood piles were stored in a pioneer grassland of Steinbach.



Figure 8. Illustration of shelters created at Calcaires de la Sambre in 2016.

f. Collection of seeds for vascular plants species for seed lots

Sub-action C.1f aimed at collecting seed lots of patrimonial plant species potentially benefiting from pioneer conditions of extraction sites. Species were selected as being characteristic of oligotrophic and sunny conditions, short-lived and patrimonial, i.e., rare, or red listed at the regional level (illustrated in Figure 9).

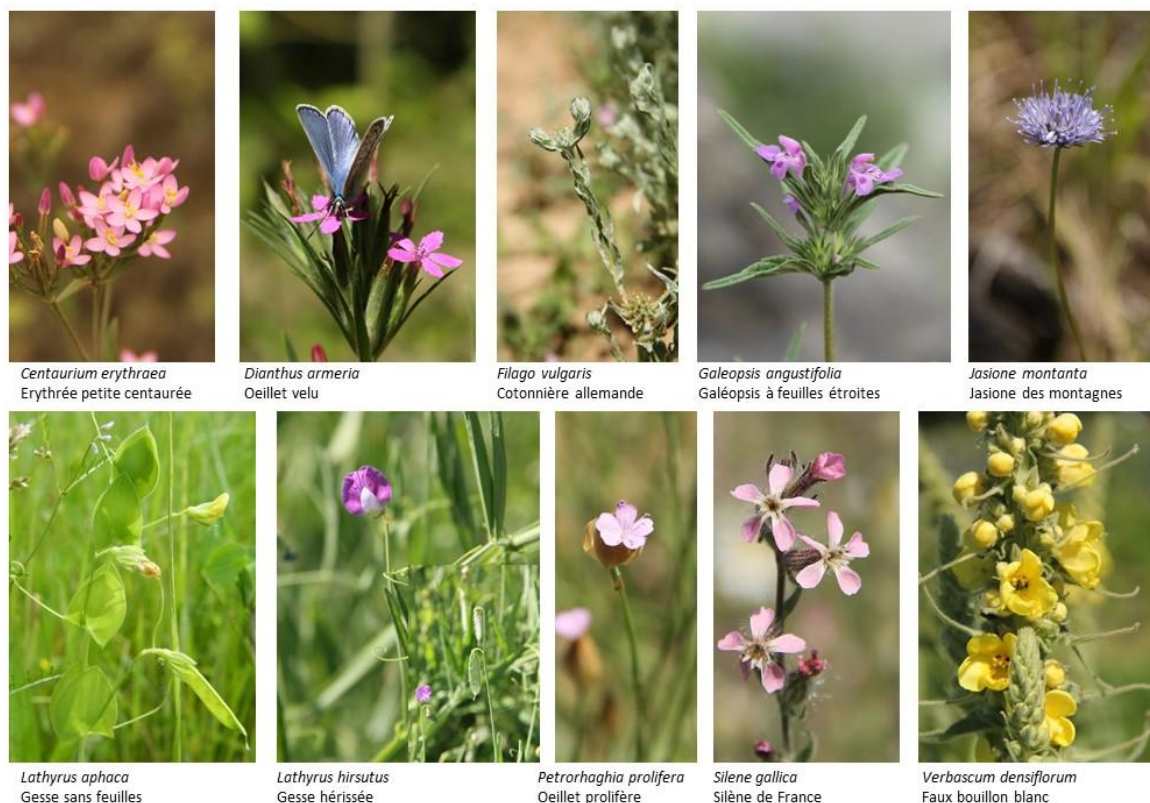


Figure 9. Illustration of 10 of the 11 species collected under sub-action C.1f. Latin and french names.

During the testing period, initially 5 then a total of 11 species were harvested in 26 populations in the 2 main biogeographical Walloon districts. They originated from wild populations or colonized quarries and were developed to be sown in different quarries of the project (under sub-action C.2b).

22 populations of the harvested seeds were launched for development in nursery and 1 collected in the wild population by Ecosem sprl for a total of 23 populations. Nursery development was supervised under a framework agreement. 3 populations were cancelled as being redundant.

The sub-action overlapping with sub-action C.2f, results were presented together in a specific note on the production reflecting 'species seeds' production periods and the more efficient collection methods/time' produced in answer to EASME.

g. Translocation tests for *Bufo calamita* and h. *Triturus cristatus*

Natterjack toad

Within Phase I sites occupied by the Natterjack toad (*Bufo calamita*), all water bodies with favorable conditions were colonized in 2016. Even newly created ponds with sufficient water level were readily colonized within weeks. This observation highlighted the existence of few restrictions for the dispersal of *Bufo calamita* when pre-existing on a site. Consequently, the foreseen test of intra-site translocations appeared irrelevant and was not implemented. It was however considered in translocations on new sites (sub-action C.2g) that multiple translocation areas could help in faster colonization of the sites.

Great crested Newt

In addition, on all four sites presenting Great crested newt (*Triturus cristatus*) in Phase I and II quarries, favorable ponds inventoried under action A.3 were already colonized by the species. Hence tests of intra-site translocations were not undertaken.

z. Actions under C.3

C.3b – Creation of linear of bank favorable to reedbeds installation

Les Petons adapted 170 m of slopes on an old pit to favor reedbeds installation. This action was realized in October 2018 and further adapted under sub-action C.3b by, among other things, digging depressions that will allow maintaining ponds during low waters.

C.3c – Placement of tern platforms

Two tern platforms were installed under action C.3c at Les Petons. Monitoring under action D.1 allowed for adjustments in subsequent platforms.

C.2 Implementation of temporary nature management plan

Foreseen start date: October 2016
Foreseen end date: October 2018

Actual start date: March 2017
Actual end date: December 2021

Action C.2 aimed at developing the dynamic management of nature. Its sub-actions were launched in the **14 Phase I quarries** (under C.4a for Phase II quarries) following the validation of action plans in sub-action A.3b. At each quarry, the provisional annual planning elaborated and/or a side planning between the quarry responsible and the partner in charge of support allowed to prioritize actions and fit them in the exploitation phases.

Until 2019, a geographical database was fed and used by the partners of the project to keep track of all C.2 sub-actions implemented on sites. From 2019 to the end of the project, the development of the AMBREs platform (under D.4) and its appropriation by quarries allowed species' online and a constant update by quarries along with the project's team.

Maps detailing all sub-actions present on sites at the time of the finalization of management plans (under action D.5) are annexed to the present report. A synthesis is included herein in Table 5.

(i) As action C.1 was implemented on the same sites as those of actions C.2, C.3 and C.4a, the C.1 outcomes are integrated as part of these actions. The objectives set under the Grant agreement and implementations presented under action C.1 are thus merged to those of action C.2 to allow reporting on total numbers, linear and surfaces of functional actions implemented over the project.

(ii) As lessons of temporary nature implementation for Phase II quarries (under sub-action C.4a) are similar to those of Phase I quarries, only the numbers are presented under C.4, lessons being presented here.

Table 5. Synthesis of C.2 sub-actions realized and committed in Phase I quarries as of the finalization of management plans (under action D.5). Objectives consist in the fusion of C.1 and C.2 sub-actions (e.g. C.1a: 10 + C.2a: 50; see comment in text)

	C.2a (n)	C.2b (ha)	C.2c – Sand martins (n)	C.2c – Solitary bees (n)	C.2d (ha)	C.2e (n)	C.2f (n)	C.2g (n)	C.2h (n)	C.2i (n)
<i>Global objectives</i>	120	12	10	-	5	96	8	4	4	1
Objectives Phase I	10+50	1+5	1+4	-	0.5+2.0	8+40	4	2	2	-
<i>Total figures of elements in place</i>	204	14.69	9	9	-	184	10	3	2	-
<i>(Commitment) –Phase I sites</i>	(150)	(11.15)	(8)	(6)	(-)	(160)	10	3	2	-

a. **Dynamic management of temporary ponds**

Disambiguation: The term 'temporary' being subject to misinterpretation as some > 5 years old ponds maintain interesting pioneer conditions for target pioneer species (Natterjack toad, Stoneworts, Blue tailed damselfly, Southern skimmer ...), the term 'temporary' was replaced over the course of the project by 'pioneer'.

Sub-action A.3b identified a large potential for the development of pioneer ponds (349 ponds - Phase I sites objective: 60). Circa 450 individual ponds were either created or set aside from day-to-day exploitation in Phase I quarries. The different pioneer ponds designs were based on report from action A.1a – *Assessment of the state of the art on temporary nature management* – and on first implementations under test sub-action C.1a.

Their creations appeared to be much faster than initially estimated (reaching up to 5 ponds/day) though success was variable depending on the substrate, year of implementation, localization (Figure 10) The presence of pre-existing pools and ponds potentially subject to impact by quarries daily activity and that could be subtracted from impacts by 'simply' protecting them from traffic and exploitation - with boulders or shelters - and leaving them evolve towards interesting oligotrophic habitats (Figure 11) led the project team

to acknowledge this new mean of ‘creation’. It led to an important increase in the number of ponds while allowing securing ‘natural’ ponds. A limited number of ponds, meant to stay in place over the long term but maintained with pioneer conditions, were lined with EPDM rubber in order to allow for flexibility in location and management (e.g. at Monts de Baileux to the benefit of the Natterjack toad and at Belle Roche which allowed to identify the presence of Midwife toad).

As summarized in Table 5, a total number of **204 functional ponds** were present at the finalization stage of management plans of Phase I quarries (under action D.5). Functional ponds are those remaining upon removal of discarded ponds and of ponds characterized as non-functional (i.e., not holding water between 2 successive – 1 month apart - surveys in 2020). While this number is expected to fluctuate over the years, the overall long-term **commitment** from the 14 Phase I quarries is to maintain a total of **150 ponds** or **250%** of the objective (see also action D.5).



Figure 10. Networks of pioneer ponds at Lannoy (left), Clypot (center) and Hermalle (right).



Figure 11. Process of setting aside pools in tracks has proven successful to develop impermeable pioneer ponds and securing new habitat for pioneer species at Jemelle (Phase II site).

Sub-actions C.2a, C.2b and C.2e were often associated to form “refuge areas” in temporarily inactive zones as illustrated in Figure 12.



Figure 12. Illustration of “refuge areas” created at Calcaires de la Sambre, where ponds are associated with rocky shelters and pioneer grasslands (humid in this case).

b. Dynamic management of associated pioneer grasslands

While sub-action A.3b identified a potential for pioneer grasslands (31.7 ha - Phase I sites objective: 6 ha). A total of 18.96 ha was mobilized at some point over the course of the project for the development of pioneer grasslands in Phase I quarries.

These areas are protected to avoid major perturbations during a period extending from 2 to 5 or more years. This duration allows the installation of targeted plants species, and colonization by pioneer animals such as the Little ringed plover (*Charadrius dubius*) or the Blue-winged grasshopper (*Oedipoda caerulea*). This timeframe is also expected to allow seeds dispersal and the development of a seed bank.

As synthesized in guidelines under sub-action D.1b, these areas can serve as hosting grasslands to inoculate, through sowing, new pioneer species – patrimonial or not - on sites.

After this 2-5 years’ timeframe, 2 main cases are considered:

- The area is still available for nature, so the surface will be disrupted with quarry machines to avoid recolonization and re-stimulate the temporary criteria;
- The area is no longer available for nature, wherever feasible part of the topsoil with associated seed bank should/could be scrapped and transferred to new pioneer areas.

As described in C1.b, 2 main types of pioneer grasslands were considered over the project: (i) **pre-existing patrimonial grasslands** being set aside from exploitation; and, (ii) **new areas** created or refreshed and sown (Figure 13).

Seed lots of pioneer (non-patrimonial) species were sown in 11 Phase I quarries (and 11 Phase II), Yvoir also benefiting from the transfer of soil seed bank through an *intra-site* transfer of soil material (Table 6).

Table 6. Indication of quarries having benefited from sowing of pioneer species (Lot 2 under ECOSEM contract).

	Monts de Baileux	Bierghes	Calcaires de la Sambre	Carrières du Hainaut	Clypot	Hermalle-sous-Huy	Lusfin	Les Petons	Steinbach	Trooz	Yvoir	Antoing	Belle-Roche	Frasnes-lez-Couvin	Gaurain	Leffe	Lessines	Mettet	Warche	Nb carrières semées
Lot 2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	18
Lot 2 – Soil Seed bank	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	1

In addition to pioneer grasslands impacted by exploitation over the course of the project, a limited number were discarded as they were not functional anymore (due to an excess of shrubs or the lack of bare ground). Table 5 summarizes the surfaces of **pioneer grasslands (14.69 ha)** present in Phase I sites’ finalized management plans (under action D.5). The overall long-term **commitment** from the 14 Phase I quarries is to maintain a total of **11.15 ha** or **186%** of the objective (see also action D.5).



Figure 13. Pre-existing patrimonial grassland set aside from exploitation at Monts de Baileux and newly created area at Steinbach.

c. Regular vertical face refreshment and creations

Vertical faces (also called ‘Loose cliffs’ and ‘Loose banks’) and sandy slopes (subsequently called ‘sand banks’) provide a suitable habitat for birds and burrowing insects among which a diversity of solitary bees. These habitats are linked to the extractive activity creating vertical faces in sand pits and in stockpiles of fine aggregates in other sites. A regular refreshment of the breeding ground is necessary to keep these areas attractive.

As a result of sub-action A.1a, the action plans considered 2 types of habitats in this sub-action:

- Large vertical faces favorable for the installation of Bank swallow (*Riparia riparia*). This type of habitat is better set in the vicinity of existing *Riparia riparia*'s colonies;
- Sand banks with bare surface benefiting solitary bees and other burrowing insects. This habitat can be considered in all quarries with the adequate substrates.

Sub-action A.3b identified a potential of 6 vertical faces and 6 sand banks in Phase I sites (objectives: 5 Vertical faces; sand banks: /). The on-site implementation led to the creation and/or management of 12 vertical faces and 10 sand banks in Phase I sites over the course of the project.

The *de novo* creation of vertical faces resulted costly in comparison to the cutting of vertical faces on fine aggregates stocks. This led the project team to counsel this second way of implementation over the course of the project.



Figure 14. Vertical face under construction at Moha and functional vertical face at Les Petons.

Sand banks were created in a diversity of areas presenting sandy substrates. Areas identified as already presenting nesting aggregations were favored for management to developing aggregations.



Figure 15. Sand banks with bare surface being refreshed to benefit to solitary bees and other burrowing insects Calcaires de la Sambre.

A total of **9 vertical faces** and **9 sand banks** were present at the management plans' finalization stage (in action D.5) with respective long-term **commitments of 8** (or **160%** of the objective) and **6** (no initial objective) (Table 5).

d. Scree management

Working on active screes was not allowed by quarries due to safety reasons, as previously mentioned (ref. Ares(2017)2537987).

While the action has been proposed to be compensated by creating additional permanent and stable larger screes accounted for in ha under sub-action C.3h as it was believed that:

- The permanent scree habitats are also interesting foraging grounds for reptiles;
- Early-stages of vegetal colonization on permanent screes corroborate with the pioneer habitats initially targeted in sub-action C.2d.

Sub-action C.3h not reaching its objective, it was decided not to further jeopardize achievements for this sub-action.

We thus propose here to replace the 5.00 ha of combined sub-actions C.1d, C.2d and equivalent in C.4a by reporting these 5.00 more hectares to pioneer grasslands (sub-action C.1b, C.2b and equivalent in C.4a). This final proposition is based on the fact that active screes analogs of N2000 Habitat 6110 were targeting plant species as well as reptiles (Wall lizard (*Podarcis muralis*) and to a lesser extent Smooth snake (*Coronella austriaca*)) that are often found in the pioneer grasslands of action C.2b (see the final biological monitoring report under action D.2). **This brings the joint commitment of action C.1b, C.2b and equivalent in C.4a to 17.00 ha.**

It is to be noted that some of the pioneer grasslands implemented under tests and further under sub-action C.2b were set in sloping terrain presenting similar conditions to that of natural active screes. This case is also true for a few cases of grazed grasslands under sub-action C.3f presenting unstable substrates.

e. Annual creation of shelters

As a result of sub-action A.1a, built shelters either consisted in:

- ‘Day shelters’ for amphibians and reptiles made as rock piles of 1 m in height with a volume of 2 to 5 m³;
- Hibernacula consisting in frost-free hides that maintaining buffered micro-climates;
- Loosened sand piles maintaining humid conditions;
- Piles of wood debris answering reptiles basking needs; or
- Hay piles and composting heaps producing heat favorable to reptiles’ reproduction.

Implemented numbers of each type were not tracked as not presenting any benefit at this level. However, while rocks or sands are easily accessible in quarries and sandpits, wood debris and hay is not as common, which led to more of the three first types - consisting in stacking rocks of 20/40 cm size allowing the maintenance of interstices - to be created.

Sub-action A.3b led to the identification of an overall potential for creation of 304 shelters in Phase I sites (Phase I objective: 48). As creation was broadly limited to the most relevant areas (i.e. areas without spontaneous hides made of stocks, screes ...), the resulting implemented number presented lower figures with 213 shelters built over the course of the project. Implementation was otherwise limited by the questioning of the added value of such shelters, this question was addressed under action D.2 through a Master thesis allowing, in 2021, to confirm interest for pioneer target species of amphibians (Natterjack (*Bufo calamita*) and Midwife (*Alytes obstetricans*) toads) among others.

184 shelters were present when finalizing management plans (in action D.5) with long-term **commitments of 160** for Phase I sites (or **333%** of the objective).



Figure 16. Examples of rocky shelter at Milieu and associated to a pond at Les Petons.

f. Development of vascular plant species

This sub-action was sub-contracted to the company Ecosem sprl who developed seed lots for 10 patrimonial plant species (see details under sub-action C.1f). As no distinction was made for the sub-contracting for Phase I and Phase II, outcomes of the action and of its equivalent in C4.a are hereafter merged.

Seeds lots were developed from 22 collected populations (representing 10 species, see sub-action C.1f for details) in a nursery's optimal growing conditions and lead to the production of large amounts of propagation material within one or two generations.

To limit genetic pollution, sowing of each lot was limited to sites pertaining to the biogeographical district of its source population. It was realized in **62** (30 Phase I + 32 Phase II sites) refuge areas – either pioneer grasslands and/or mowed or grazed grasslands of **20 sites** (9 + 11 sites) between 2018 and 2021 (Table 7). Number of sown sites per species is presented in Table 11 (under action D.2 for f). Maps of areas sown are annexed to the present report.

Table 7. Count of areas (pioneer grasslands, grazed grasslands, mowed grasslands) having benefited from sowing of patrimonial pioneer species (Lot 1 under ECOSEM contract) in 20 quarries.

	Monts de Baileux	Bierghes	Calcaires de la Sambre	Carrières du Hainaut	Clypot	Milieu	Les Petons	Trooz	Yvoir	Antoing	Belle-Roche	Ermitage	Frasnes-lez-Couvin	Gaurain	Jemelle	Leffe	Lessines	Marche-les-Dames	Mettet	Quenast	Total (n)
Lot 1	2	2	2	3	4	4	7	4	2	4	3	2	2	3	6	3	1	4	2	3	62
	(1)	(1)	(2)	(2)	(3)	(3)	(7)	(4)	(2)	(3)	(3)	(0)	(2)	(2)	(5)	(2)	(0)	(1)	(2)	(2)	(47)
Number of sown species	4	2	4	2	4	4	4	3	3	6	3	3	2	4	4	3	3	5	1	3	

() : Number of areas being surveyed during the Master thesis of Johan Jacob aiming at monitoring installation success of sown species.

For 16 seed lots representing 10 species, a partnership agreement between the Meise botanical garden and ULiège-GxABT allowed to conserve over the long term 50 g of seeds for each of these 16 populations. These come to complete the conservation of red list species developed by the Botanical garden. The agreement stipulates that lots are to be dedicated to conservation or research projects.

g. Translocations of *Bufo calamita*, h. of *Triturus cristatus* and i. Breeding of *Bombina variegata*

Following the acceptance of derogations requests from the regional administration in charge of nature following action A.3a, the introductions could proceed with:

- For the **Natterjack toad**, the transfer of egg strings segments allowed translocating large number of individuals. The collection was limited to c. 20% of source spawns to avoid impacts on native populations.

For each receptor site, a maximum of 20 000 eggs - 100 fragments each representing c. 200 eggs and originating from 2 populations - was set as a target. Transfers from 8 sites were realized towards 5 new sites (Phase I under C.2h: Monts de Baileux, Hermalle and Les Petons (i.e., 150% of g objective), and 2 Phase II.1 under C.4a-C2.g: Gaurain, Jemelle; i.e., 100% of C.4a-g objective) over the course of 3 years;

- **Great crested newts** were transferred following an innovative egg collecting method: by encouraging females to lay spawns on plastic strips. An initial transfer objective for the **4 quarries** (3 Phase I under C.2h: Bierghes and Clypot (i.e., **100%** of C.2h objective); and 2 Phase II.1 under C.4a-C2.g: Marche les Dames and Quenast (i.e., **100%** of C.4a-C.2h objective)) was determined at 2000 eggs originating from 3 source sites. Final numbers ranged between c. 2500 and 13 000 over 2 to 3 years;
- Some 1300 **Yellow-bellied bred toadlets** were released in temporary refuge areas of **one Phase II quarry** (Warche (i.e., **100%** of C.2i and C.4a-C.2i combined objective)). While time consuming, the captive breeding method was best fitted to a limited number of adults available and resulted in a high number of well-developed off-springs with higher survival rates expected. It was realized in collaboration with the Domaine des Grottes de Han;
- While the potentialities for **Midwife toad** translocations was studied, the important constraints linked to sanitary protocols for the species did not allow to go on with implementation. It is however a potential development which the PNPE partner would be willing to implement in the future (e.g., as part of the After-LIFE plan, see F.3) benefiting from the LIFE BNIP (LIFE14 IPE/BE/000002) experience.

Complementary actions outside LIFE:

As far as possible, the LIFE in Quarries favored local partnerships between affiliated quarries nature conservation association for long-term. As a result, contacts were initiated with NGOs to facilitate complementary actions outside of the LIFE in Quarries scope, e.g.:

- **ASPEI**: association working towards promotion and conservation of indigenous crayfishes (<http://www.aspei.be>). Collaboration was initiated to evaluate the potential for indigenous crayfishes in large water bodies of participating quarries;
- **Patrimoine Nature**: naturalist association active in the eastern part of Belgium (<http://www.patrimoinenature.be>). Future collaborations are expected following contact between the association and Steinbach and Warche quarries;
- **Les Bocages asbl**: association of nature conservation active in the south of Belgium (<http://www.lesbocages.be>). The extensive experience with the quarry company Carmeuse in the construction of vertical faces for sand Martins has benefited the project's implementation within CarMeuse sites (Moha and Frasnès and Les Petons quarries);
- **Meise Botanical garden**: By allowing safekeeping seed lots in optimal condition and allowing use of patrimonial species seeds (Lot 1) for conservation purposes, the agreement between ULiège-GxABT and the Meise Botanical garden (<http://www.br.fgov.be/>) ensures that the development of these resources can be useful to future restoration projects;
- A fruitful collaboration with the LIFE BNIP allowed supporting the translocations actions of Great crested newt in the Senne river basin along with the Contrat Rivière Senne and the LIFE BELINI.

Technical problems / delays:

While most actions could be implemented right from the start, the continuation of the progress and extension allowed fine-tuning of some specificities at the site level. This led to progressive delivery of actions throughout the project and end dates for realizations set when all commitments allowing for relevant long-term management plans had been implemented. These delays, while potentially affecting the delivery of management plans under D.5, allowed further raising quarry staff's awareness and led to higher final commitments under the same D.5 action.

For the specific translocation actions, the initial timeframe was too short for:

- C.2 – Translocations of amphibians as delays occurred for *Triturus cristatus* and *Bombina variegata* to meet all the requirements such as suitable habitats creation, identification of source populations, authorization from regional authority... additional time granted to the project allowed to add one year of introduction for all three amphibians under optimal conditions, further enhancing chances of success. Further implementation will be realized in the After-LIFE plan (F.3).

C.3 Implementation of permanent nature management plan

Foreseen start date: October 2016
Foreseen end date: October 2019

Actual start date: March 2017
Actual end date: December 2021

Action C.3 aimed at showing that restoration can be thought during the life of the quarries in areas now outside of any future extractive impact. As planned, it resulted from action A.3 and aimed at integrating outcomes of A.6 to redirect restoration schemes towards a maximization of ecosystem services. As for action C.2, its sub-actions were launched in the **14 Phase I quarries** (under C.4 for Phase II quarries) following the validation of action plans in sub-action A.3b.

The action first fed a geographical database and then the AMBREs platform (see comment under action C.2).

A synthesis of all sub-actions present on sites is included herein in Table 8.

(i) As action C.1 was implemented on the same sites as those of actions C.2, C.3 and C.4a, the C.1 outcomes are integrated as part of these actions. The objectives set under the Grant agreement and implementations presented under action C.1 are thus merged to those of action C.2 to allow reporting on total numbers, linear and surfaces of functional actions implemented over the project.

(ii) As lessons of permanent nature implementation for Phase II quarries (under sub-action C.4a) are similar to those of Phase I quarries, only the numbers are presented under C.4, lessons being presented here.

Table 8. Synthesis of C.3 sub-actions realized and committed in Phase I quarries as of the finalization of management plans (under action D.5).

	C.3a (n)	C.3b (m)	C.3c – Ternis (n)	C.3c – Common gull (n)	C.3c – Islet (n)	C.3d (n)	C.3e (ha)	C.3f (ha)	C.3g (m)	C.3h (m)
<i>Global objectives</i>	24	400	16	-	-	4	10	50	200	8000
Objectives Phase I	12	200	8	-	-	2	5	25	100	4000
<i>Total figures of elements in place</i>	87	605	6	13	1	8	13.66	33.96	-	3744
<i>(Commitment) – Phase I sites</i>	(72)	(560)	(6)	(10)	(1)	(8)	(13.35)	(30.75)	(-)	(3450)

a. **Creation of permanent ponds >25m²**

A potential of 116 ponds was identified under sub-action A.3b for the Phase I quarries (Phase I sites objective: 12). While a larger share of ponds was dug, as for pioneer ponds a limited number of ponds were ‘simply’ set aside from exploitation or cured over the project (Figure 17).



Figure 17. Illustration of permanent ponds set aside and being cured at Hermalle (left) and dug in humid zones at Monts de Baileux (right).

Most ponds were however realized by digging large dips in areas collecting water that are not expected to be exploited anymore in the future (Figure 17). In case the presence of permanent water would have presented a high added value, but the substrate or available localizations did not allow retaining water, ponds were

sealed using overburden clay material (e.g., at Clypot, Figure 18) or lined with EPDM rubber (e.g., at Milieu, Lustin). Water supply was expected either from rainwater or by runoffs.



Figure 18. Before/After : Permanent pond dug and lined with clay at Clypot.

Table 8 summarizes the total number of **functional permanent ponds (87)** present at the at the finalization stage of management plans of Phase I quarries (under action D.5) and revised as 'functional', i.e., as presenting water in May-June. This number is expected to remain constant (or increase) over the years as part of the permanent actions package. The 14 phase I quarries committed to maintain **72 ponds** or **275%** of the objective. The difference of 15 ponds is linked to the subtraction of ponds for which the certitudes on long term viability was difficult to establish with risks of silting, uncertainties on impermeability or a young age not allowing for some hindsight.

b. Creation of linear of bank favourable to reedbeds installation

While sub-action identified a potential of c. 125 m (Phase I sites objective: 200 m), 963 m were recorded over the project. This figure is artificially high, as it comprises some multiple recording of the same banks linked to adaptations in the banks.

The action, consisting in favoring the implementation of reedbeds or aquatic vegetation on lakes and large ponds by softening their slopes and creating shallow banks was implemented in 6 quarries. It either consisted in adjusting old extraction waterbodies (in Sablières Lannoy and Les Petons, Figure 19) through excavation in soft material of filling with overburden in hard rock quarries or in the adjustment of otherwise steep technical basins by a sloping of their banks (in Figure 20).

The implementation as originally planned and extension to technical basin of Phase I sites exceeded the originally identified potential. The 14 phase I quarries committed to maintain **560 m of banks** or **280%** of the objective. Differences are explained by rounding of commitments. This allowed reaching the project overall objective while implementation in phase II sites did not reach its target (see sub-action C.4a-C3.b).



Figure 19. Softening of the slopes in the sandpit of Sablières Lannoy (left) and by addition of overburden material at les Petons (right, see outcomes in action D.2).



Figure 20. Sloping of technical basins banks at Milieu (Left) and Hermalle (right).

c. Placement of tern platforms

A potential of **6** Tern platforms was identified, implemented and committed in 3 Phase I quarries: Les Petons, Moha and Hermalle (Objective phase I: 8, i.e., **75% of the objective**) (Figure 21). As an alternative to large platforms, a potential of 5 small ones, expected to favor Common gull and Black headed gull was identified as relevant. Evaluated interesting, 13 small platforms were built during a specific training session (under sub-action E.5a) resulting in **13 installations** and a **commitment to maintain 10** over the long term. The joint commitment thus represents 16 platforms or **200%** of the Phase I objective.

Tern platforms initially foreseen were inspired from a realization at Etangs de Virelles⁶. After market analysis, it appeared that no suitable commercial version of floating platforms was available at reasonable price (see below). Hence, it was decided to design and construct a test version corresponding to the layout initially considered. The first version consisted in a raft-like wood structure (3 x 3 m) on 4 floats covered with a mineral substrate (quarry production) to avoid vegetal colonization and offer adequate nesting, resting, or fishing grounds. The number of floats was latter adapted to 6 and then to 2 larger ones resulting more stable at a lower cost. A test with PEHD tubes as float revealed unpractical and was abandoned while one raft realized with polystyrene float was not reproduced as it proved less practical. The action led to the creation of a short, illustrated report developing technical prescriptions.

Common gull platforms consisted in 1m² small woody platforms filled with polystyrene. The design was based on previous experience of PNPE. These were anchored on smaller waterbodies allowing compensating for the lack of large waterbodies available to install large platforms.

As another additional action, **1 islet** was set in place at Sablières Lannoy by isolating a sandbar in a large waterbody. This latest action was implemented to favor waders on the site.



⁶ See http://www.aquascope.be/etang/protection_sternes.html



Figure 21. Floating platforms built along with quarry staff at Moha (top) and in place at Les Petons (bottom).

d. Securing of chiropters galleries

A large potential of 15 galleries for chiropters was identified among old quarries dependencies of Phase I: lime-kilns, technical galleries, old houses ... (Phase I sites - objective: 4).

A prioritization based among other factors on bats' inventories during winter 2017-2018 allowed further selecting the most relevant galleries for their securing. While most galleries were secured in 2020 under a public tender and LIFE in Quarries funds, a few were secured by quarries.

For Phase I sites, 1 gallery was created with blocks from cut stone within a spoil heap (Figure 22). This action is likely a first in the Walloon region and long-term monitoring will be of prime interest for creation of bats hibernation grounds in the region. Galleries were secured and fitted with micro-hides in accordance with specific targeted species' needs by the quarry personnel (1), through public tenders attributed to society Justin Vandebussche (5) and by the PNPE workers team (2). In the case of Milieu, it first required a stability expertise taken in charge by the LIFE in Quarries.



Figure 22. Construction of a bat gallery with stone blocks within a spoil heap at Carrières du Hainaut. A metal door was then installed at the entrance by the LIFE in Quarries.





Figure 23. Galleries secured at Monts de Baileux (old lime kiln - top) - with micro-hides installed for bats -, Calcaires de la Sambre (old technical gallery – bottom left) and Lustin (technical gallery – bottom right).

A total of **8 galleries**, or **200%** of the Phase I objective, were secured, present at the finalization stage of management plans, and included in the long-term **commitments** of the 14 quarries (Table 8). There is still perspective for implementation in collaboration with PNPE and/or Plecotus-Natagora in the After-LIFE (action F.3).

e. Restoration and management of mowed grasslands, and f. Restoration and management of grazed grasslands

! For C.3e and C.3f objectives, and equivalent in sub-action C.4a realizations are presented here jointly.

The restoration of mowed or grazed grasslands of biological interest went through the setting of a grazing or mowing regime on oligotrophic or mesotrophic substrates.

Action A.3 showed the existence of 2 main cases for sub-action C3.e:

- **Pre-existing mowed grasslands restoration** among quarries dependencies that could simply benefit from a biodiversity management scheme. For these habitats, we suggested limiting restoration to the maintenance of mosaic-type/late-mowing, made durable through agri-environmental schemes signed with farmers. When necessary, light restoration was specifically considered with the sowing of an adapted diversified seed mix.
- **Restoration of mowed grasslands** from scratch with heavier works such as soil preparation (superficial or fill back with overburden material) and enrichment sowing. Upon restoration, the habitat will be maintained by mosaic-type/late-mowing with agri-environment schemes (Figure 24).

To the exception of smaller areas presenting a high patrimonial value (e.g. orchid grasslands in front of offices, mechanically managed sites' borders), the sequence for implementation was common with sub-action C.3f that aimed at developing grazed grasslands.



Figure 24. Patrimonial grassland on a spoil heap to be mown at Marche les Dames.

The following stages were followed for the implementations:

1. Identification of large areas outside of the exploitation plan (peripheric properties or post-exploitation areas) with biological interest or potential to create open habitats;

2. Discussion with the quarry managers and the LIFE in Quarries team to restore the areas with a long-term commitment under the engagement charters;
3. Legal revision of existing permits to ensure free-obligation on the areas of concern;
4. Identification of a breeder or a farmer that could be interested in managing the area under agri-environmental measures (MAEC) "Prairie de Haute valeur biologique"⁷. The objective of such engagement in the project is important as it ensures an adequate management of the areas by:
 - providing financial indemnities to the farmer respecting precise technical specifications;
 - providing a post-LIFE follow-up by Natagriwal;
 - securing an adequate management for the quarry managers.
5. On site visits of 20.7 ha of mowed grasslands and 92 ha of potential grazed grasslands with all stakeholders:
 - LIFE in Quarries team,
 - Quarries environmental responsible/manager,
 - Local breeder/farmer interested in the management of the areas;
 - Natagriwal;
 - Scientific expert of the Walloon region (DNF, DEMNA), and
 - Land owner, if applicable;
6. delineation of exacts perimeters and modalities of mowing/grazing allowing for an effective biological restoration of the area;
7. Public tenders redacted by the LIFE in Quarries team;
8. Permitting demands realized along with quarry partners in cases where woods had reclaim the areas and derogation demands in case of impacts on protected species;
9. Implementation of actions under the supervision of the LIFE in Quarries team with input from farmers or shepherds;
10. Transfer to the shepherd or farmer in charge.

The sequence of action was coordinated by ULiège-GxABT with joint contributions from all partners. The public tenders were under the coordination of:

- FEDIEX for the fences;
- ULiège-GxABT for the deforestations;
- ULiège-GxABT for the sowing;

all with technical guidance provided by partners.

⁷ <https://www.natagriwal.be/fr/mesures-agro-environnementales/liste-des-mae/fiches/details/332>



Figure 25. Stages of the process implemented for the restoration of mowed and grazed grasslands: Visit with Natagriwal expert followed by soil preparation and sowing of mowed grassland at Marche les Dames; fencing and presence of sheep at Clypot.

Restoration of the areas with deforestation, installation of infrastructures (fences) and, when relevant, sowing of grasslands plant species was realized between 2018 and 2021:

- 1 Phase I sites and 6 Phase II sites were subjects of public tenders for vegetation clearance (i.e. trees cutting);
- the preparation and mowing of parcels under C.3e and C.4a equivalent was set in place:
 - in 5 Phase I sites for a total of 13.66 ha and **commitments of 13.35 ha** or **272%** of the Phase I objective of 5 ha;
 - in 5 Phase II sites for a total of 15.88 ha and **commitments of 14.75 ha** or **295%** of the Phase II objective of 5 ha;
- the fencing and grazing of parcels under C.3f and C.4a equivalent was set in place:
 - in 5 Phase I sites for a total of 33.96 ha (except for Trooz where goats roam freely) and **commitments of 30.75 ha** or **123%** of the Phase I objective of 25 ha;
 - in 5 Phase II sites for a total of 44.67 ha and **commitments of 44.35 ha** or **177%** of the Phase II objective of 25 ha;
- 9 sites benefited from Lot 4 – dedicated to permanent grasslands – sowing. For 3 sites, the harvesting of seeds allowed collecting local seeds with cheaper prices for delivered seeds (Table 9).

Table 9. Indication of quarries having benefited from sowing of Stonecrops (*Sedum sp.*) and/or of grasslands species (Lot 3 and Lot 4 under ECOSEM contract).

	Monts de Baileux	Bierghes	Carrières du	Clypot	Hermalle-sous-Huy	Milieu	Les Pétons	Trooz	Antoing	Gaurain	Leffe	Marche-les-Dames	Quenast	Nb carrières semées
Lot 3	x	x	x	x	-	x	x	x	x	x	-	-	x	10
Lot 4	-	x	-	x	-	x	x	x	x	x	-	x	x	9
Lot 4 - Harvest	-	-	-	-	x	-	-	x	-	-	x	-	-	3

g. Restoration of scree through last blasting

This innovative idea to create scree with blasting appeared difficult to implement in quarries under activity due to security risks. However, the method would be very interesting to create scree at a final stage when activity will cease in the quarry and hence be part of the rehabilitation. This potential could not be identified within the project's quarries.

h. Creation of linear scree

Following the identification of a 4657 m potential for linear scree creation (Phase I sites objective: 4000 m). The sub-action was implemented in 9 phase I quarries with a total of 4694 m implemented at some point over the course of the project. This figure is artificially high, as it comprises some multiple recording of the same scree linked to adaptations in the registering.

The action principally targeted reptiles and specifically Smooth snakes (*Coronella austriaca*) and Wall lizard (*Podarcis muralis*) with an objective of connecting areas and creating edge habitat for sites with populations. This pre-requisite broadly limited the geographic range of implementation, as both species are mainly found in the Continental domain south of the Meuse River. Some linear scree were however also implemented in northern sites (Atlantic domain) as a mean to create large shelter like structure for the micro-fauna among which amphibians such as the Midwife toad (*Alytes obstetricans*).



Figure 26. Permanent linear Scree realised at Hermalle and Les Petons bordering mowed grasslands and a now fenced grazed grassland.

A total of 3744 m of linear scree were present on Phase I sites upon finalization of the management plans with a **long term commitment of 3450 m** or **86% of the objective**. Lower figures for Phase II sites (see C.4a-C.3h) did not allow compensating for the deviation. As already stated in successive reports and Progress report #4 we could identify the following explanations for the deviation:

- Overestimation of the initial objective with most relevant sites situated south of the Meuse river according to biological stakes (reptiles) i.e. Atlantic vs continental region;
- The cost for the rocks (consumables) has doubled from the initial budget. This confirms that the material has been mobilized by the quarry operators, but the scree is often over-sized compared to initial plans due to difficulties to make <2m thin linear scree as was expected in the proposal;

Outcomes led the team to cheer quarry staff for implementation by proposing implementation with uncalibrated rocks resulting less expensive and still interesting in terms of granulometry and heterogeneity.

Technical problems / delays:

Despite the availability of the 14 actions plans in March 2017, some delays appeared in the launching of the C.3 actions for the following reasons:

- Launching of the actions plans defined under A.3b was time-consuming to fit in the quarry activities and budgets;
- Global appropriation by the sector was slower than initially expected so that the implementation of the actions on site needed a lot of support and follow-up by the LIFE team;
- Implementation of C.3 actions needed additional preliminary work to be launched such as meetings with experts to define best biological assets (C.3d, C.3e, C.3f), search for shepherds and farmers (C.3e and C.3f), preparation of public tenders, internal prioritizations with best value for budget ...

- C.3f – C.4a-C.3f: installation of fences for grazed grasslands. The choice was made to call for a single and global tender for the 9 quarries concerned by this action. Innovative for quarry staff, the procedure led to multiple exchanges and resulted complex in finalizing all perimeters with the necessary requirements and launching the tender call. However, the tender was awarded to 2 companies (i.e. Clotures Neuville SPRL, Les jardins de Léa SPRL);
- C.3e and C.3f and equivalent in C.4a: some areas required some deforestation to restore open grasslands. On a few sites, the timing was delayed with prices of chopped wood falling and entrepreneurs lagging behind in their possibilities to evacuate it from sites (e.g. in the case of Quenast and Marche les Dames);
- Comments under action C.2 apply to C.3 as well.

While there was a real opportunity to restore 3-4 ha of sandy grasslands at Sablières Lannoy under sub-action C.3f, the African swine flu epidemic that occurred in 2018 in southern Belgium led to the cancellation of this action. It is however now considered under the LIFE Connexions project (LIFE19 NAT/BE/000093).

Long-term commitment for habitat restoration:

The suitably long period suggested by the LIFE guideline states a period of ideally 30 years or longer. In the project, discussions with quarries and GT-LIFE revealed reluctance in signing a 30 years charter for the following reasons:

- Land owned by private commercial companies;
- Visibility on economic exploitation of the quarries is usually shorter than 30 years;
- Existence of case of “Force majeure” such as interruption of extractive activity, company goes under bankruptcy proceedings, sold to new mother company;

Based on these exchanges, a request to adapt commitments to a renewable 15 years charter was submitted to EASME.

The proposition for 15 years charter was inspired by the EU rural development program 2014-2020 implemented in Wallonia where funds are available, under M7.6⁸, for restoration works of habitats of community interest. Restoration of non-priority habitats, such as the one targeted by the LIFE in Quarries project, requiring 15 years commitments.

Complementary actions outside LIFE:

- Natagriwal ASBL: The grazing and mowing of most sites was made possible thanks to the contribution of Natagriwal ASBL whose experts joined the visits for strategic decisions in the implementation of long term management (under sub-actions C.3e and C.3f and equivalent in C.4a) and collaborated for the definition of and to find farmers and herders.
- Ardenne et Gaume: Grazing could be implemented on Leffe quarry thanks to the involvement of the Ardenne et Gaume NGO (<https://ardenne-et-gaume.be/>) in partnership with Natagora.
- “LIFE ELIA-2”: Following the LIFE ELIA project success (LIFE10 NAT/BE/000709), the electric line manager ELIA commits to further implement its biodiversity strategy under High voltage power lines, on own resources. On the site of Gaurain, a request to integrate a 2.07 ha fenced parcel into the LIFE in Quarries management plan allowing securing its long-term management was brought by Ecofirst Scrl (<https://www.ecofirst.eu/en/>), in charge of the implementation for ELIA;
- As stated in Annex II of the Grant Agreement, initiated discussions on the inclusion of some parcels under grazing or mowing regimes into Natural Reserves could allow the transfer of land stewardship to NGOs. Discussions are in progress for some parcels of Quenast, Hermalle, Leffe and Sablières Lannoy (under the LIFE Connexions).

⁸ Rural Development Program 2014-2020 in Wallonia (PwDR) – M7.6 – Restauration de pelouses, de lands et d’habitats situés en Natura 2000 et dans la structure écologique principale (SEP) – see https://www.natagriwal.be/sites/default/files/kcfinder/files/Folder_brochure/A5-Guide-Indem-FR-WEB-Comple.pdf

C.4 Generalisation at Regional and International level

Foreseen start date: October 2018
Foreseen end date: September 2020

Actual start date: October 2018
Actual end date: December 2021

Action C.4 aimed at reproducing actions undertaken in C.1 to C.3 on Phase II supplementary sites (under sub-action a) as well as to test the transfer of the outcomes at an international level (under sub-action C.4b).

The development of the project in two phases allowed Phase II sites to benefit of Phase I outcomes: process of inventories and management plans development (A.3), actions implementation (C.1 to C.3), and allow from adjustment thanks to the first phase of monitoring (D.1 and D.2) and from the methods subsequently developed. By splitting Phase II into Phase II.1 (10 sites) and Phase II.2 (3 sites), the project led to engage 3 new volunteer quarries in 2019. Over the course of the project, one Phase II site - Mettet – left the project because of permanent cease of exploitation leading to the figure of 13 new sites involved to evolve to 12.

In practice the extension in the timing of implementation of actions C.2 and C.3, the co-development of charters for both phases under D.5 and the delayed writing of the methodological guide under E.5, led to overlaps between Phase I and Phase II sites. This conduction of actions in parallel in both phases allowed optimizing the outcomes of time consuming actions such fencing (under C.3f and C.4a equivalent), securing of chiropter galleries (under C.3d), development of coherent management plans and signing of charters (under D.5) Nevertheless, the experience of field implementation in Phase I allowed for a smoother implementation of action A.3 and, in particular, the definition of more relevant action plans under (sub-action) A.3b for Phase II sites.

Outcomes of the whole process through both Phases and acquired experience led to suggest well-honed and solid actions when visiting international sites under C.4b.

a. **Reproducing actions C2 and C3**

Lessons learned in Phase II quarries under C.4a being similar to those of Phase I quarries, they are presented under actions C.2 and C.3 for temporary nature and permanent nature respectively.

Maps detailing all sub-actions present on sites at the time of the finalization of management plans (under action D.5) were produced. A synthesis is included herein in Table 10).

Table 10. Synthesis of C.4a realized and committed in Phase II quarries as of the finalization of management plans (under action D.5). Sub-actions codes are those of the equivalent C.2/C.3 sub-actions.

	C.4a-C.2a (n)	C.4a-C.2b (ha)	C.4a-C.2c – Sand martins (n)	C.4a-C.2c – Solitary bees (n)	C.4a-C.2d (ha)	C.4a-C.2e (n)	C.2f (n)	C.4a-C.2g (n)	C.4a-C.2h (n)	C.4a-C.2i (n)	C.4a-C.3a (n)	C.4a-C.3b (m)	C.4a-C.3c – Terns (n)	C.4a-C.3c – Common gull	C.4a-C.3c – Islet (n)	C.4a-C.3d (n)	C.4a-C.3e (ha)	C.4a-C.3f (ha)	C.4a-C.3g (m)	C.4a-C.3h (m)
<i>Global objectives</i>	<u>120</u>	<u>12</u>	<u>10</u>	-	<u>5</u>	<u>96</u>	<u>8</u>	<u>4</u>	<u>4</u>	<u>1</u>	<u>24</u>	<u>400</u>	<u>16</u>	-	-	<u>4</u>	<u>10</u>	<u>50</u>	<u>200</u>	<u>8000</u>
<i>Objectives Phase II</i>	60	6	5	-	2.5	48	4	2	2	-	12	200	8	-	-	2	5	25	100	4000
<i>Total figures of elements in place (Commitment) – Phase II sites</i>	199 (150)	16.06 (13.95)	5 (3)	9 (8)	- (-)	219 (170)	8 (7)	4 (2)	4 (2)	1 (1)	56 (47)	77 (70)	2 (2)	9 (9)	-	4 (4)	15.88 (14.75)	44.67 (44.35)	- (-)	1693 (1600)

« * » : Site that left the LIFE in Quarries project following its end of activity and did not commit on the long-term.

C4a-C2a. Dynamic management of temporary ponds

Sub-action A.3b equally identified a large potential for the development of pioneer ponds in Phase II sites (Phase II.1: 434 + Phase II.2: 54 = 488 ponds - Phase II sites objective: 60). Implementation led to 288 (275+13) individual ponds either created or set aside.

A total number of **199 functional ponds** were present at the finalization stage of management plans of Phase II (under action D.5) while the overall long-term **commitment** from the 13 Phase II sites is to maintain a total of **150 ponds** or **250%** of the objective (Table 10 - see also action D.5).



Figure 27. Network of small pioneer ponds targetting Yellow-bellied toad at the Warche quarry (left), lined pond targetting Midwife toad at Belle Roche (center) and set aside pioneer ponds at Frasnes lez Couvins (right) .

C4a-C2b. Dynamic management of associated pioneer grasslands

From the potential of 33.8 (26.9 + 6.9) ha identified under sub-action A.3b (Phase II sites objective: 6 ha), a total of 17.2 (15.11 + 2.09) ha was mobilized at some point over the course of the project.

Finalized management plans comprised **16.06 ha** of such grasslands, while the overall long-term **commitment** from the 13 Phase II quarries is to maintain a total of **13.95 ha** or **233%** of the objective (Table 10 - see also action D.5).



Figure 28. Pioneer grasslands set aside at Frasnes lez Couvin (left) and at Jemelle (right).

C4a-C2c. Regular vertical face refreshment and creations

Sub-action A.3b identified a potential of 12 (12 + 0) vertical faces and 19 (18 + 1) sand banks in Phase II sites (objectives: 5 Vertical faces; sand banks: /). The on-site implementation led to the creation and/or management of 6 (6 + 0) vertical faces and 11 (9 + 2) sand banks over the course of the project.

A total of **5 vertical faces** and **9 sand banks** were present at the management plans finalization stage (in action D.5) with respective long-term **commitments of 3** (or **60%** of the objective) and **8** (no initial objective) (Table 10 - see also action D.5). The lower value for vertical faces was linked to a limited number of Phase II sites presenting colonies of sand martins and adequate substrate for creation of vertical faces. It was however compensated by the high number of sand banks and higher numbers in Phase I sites under sub-action C.2c.



Figure 29. Vertical faces for sand martins at Jemelle (left) and opening of sand banks for solitary bees at Quenast (right).

C4a-C2d. Scree management

As previously stated under C.1 and C.2, the action could not be implemented in Phase II sites for security reasons.

C4a-C2e. Annual creation of shelters

A potential for creation of 326 (254 + 72) shelters was identified under sub-action A.3b in Phase I sites (Phase II objective: 48). This led to 222 (179 + 43) shelters to be built over the project.

219 shelters were present when finalizing management plans (in action D.5) with long term **commitments of 170** for Phase II sites (or **354%** of the objective) (Table 10)..



Figure 30. Shelters protecting a pioneer pond at Warche (left) and woody piles resulting from habitat restoration at Quenast (right).

C4a-C2f. Development of vascular plant species

Implementation of the seed lots development and use for sowing is presented under sub-action C.2f and Table 7.

C4a-C2g. Translocations of *Bufo calamita*, h. of *Triturus cristatus* and i. Breeding of *Bombina variegata*

Implementation of amphibians' translocations development and use for sowing is presented under sub-action C.2g Translocations of *Bufo calamita*, h. of *Triturus cristatus* and i. Breeding of *Bombina variegata* and in Table 10.

C4a-C3a. Creation of permanent ponds >25m²

Ponds were identified as potential for implementation in Phase II sites (Phase II objective: 12). The implementation led to the 79 (72 + 7) ponds to be present at one point in the project, this number encompassing unsuccessful trials.

Upon finalization of management plans, **56 ponds were categorized as functional, 47 or 391 % of the objective being committed** for the long-term implementation, the difference being justified, as in C.3a, by uncertainties on the long-term viability of a number of ponds (Table 10).



Figure 31. Permanent ponds adapted over the project at Gaurain (left) and newly dug at Ermitage (right).

C4a-C3b. Creation of linear of bank favorable to reedbeds installation

395m of potential was identified for the adjustment of banks in Phase II sites (objective: 200m) (Table 10). The adjustment of technical basins expected to allow a large potential to be implemented resulted difficult to implement within the timeframe of the project as one of the main basin expected to be contributing resulted being lined with EPDM with sloping difficult to set in place. This resulted in 81 (81 + 0) m implemented.

At the end of the process, **77 m of shallow banks** in place at the finalization stage of management plans and a long-term **commitment of 70 m or 35%** of the objective for Phase II quarries compensated by the higher linear set in Phase I sites.



Figure 32. Sloping / creation of high waters in a technical basin at Warche quarry and its use by ducks in winter 2020.

C4a-C3c. Placement of tern platforms

A potential of 4 (2 + 2) tern and 7 (7+0) common gull platforms were identified in Phase II sites (objective: 8 tern platforms). 2 tern platforms (i.e. **25 % of Phase II objective**) could be installed and committed in 1 Phase II.1 quarry: Lessines; and **9 Common gull platforms** installed and committed in 3 quarries. The joint commitment thus represents 16 platforms or **138%** of the Phase II objective (Table 10).



Figure 33. Finalised platform at Lessines prior to positioning on the quarry's old inundated pit.

C4a-C3d. Securing of chiropters galleries

8 (6 + 2) potential galleries were identified among dependencies (Phase I sites - objective: 4).

4 (**3 + 1**) galleries, or **100%** of the Phase II objective, were secured, present at the finalization stage of management plans, and included in long-term **commitments** (Table 10). All 4 Galleries were secured and fitted with micro-hides in accordance with specific targeted species' needs by the quarry personnel along with the LIFE in Quarries team. While 3 of the 4 galleries presented chiropters, a specific adaptation of an old milling installation expected to be favorable to chiropters was realized at Marche les Dames by controlling light and humidity through backfilling of part of the entrance of the gallery (Figure 34).



Figure 34. Old milling installation at Marche les Dames prior, during and after securisation.

As for Phase I sites, a potential for further implementation remains in Phase II quarries and could be implemented under the After-LIFE.

C4a-C3e. Restoration and management of mowed grasslands, and f. Restoration and management of grazed grasslands

Stages and implementation of the restoration of mowed and grazed grasslands is presented under sub-action C.3e Restoration and management of mowed grasslands, and f. Restoration and management of grazed grasslands. Summary of surfaces involved for Phase II sites is presented in Table 10.

C4a-C3g. Restoration of scree through last blasting

Comments presented under C.30.

Restoration of scree through last blasting apply to Phase II sites as well as relevant opportunities for this sub-action could not be identified in the 13 additional quarries.

C4a-C3h. Creation of linear screes

Sub-action A.3b allowed identifying a 3535 (3333 + 202) m potential; short of the Phase II objective (4000 m). It was then implemented in 5 quarries for a total of c. 1800 m.

From these, a total of **1693 m** were present upon finalization of management plans, **1600 m being committed for the long term**, i.e. **40% of the Phase's objective**. This deviation is coherent with justification provided under sub-action C.3h with an overestimation of the true potential for the action and an important cost associated to the action.



Figure 35. Linear screes bordering a mowed grassland at Marche les Dames (left) and integrated to a grazed grassland at Leffe (right).

b. Generalisation at International level

While travel restrictions across EU linked to the Covid-19 crisis complicated the organization of international visits and led to some delays for sub-action C.4b, the objective of visiting 2 quarries in 3 EU countries could be achieved thanks to a definite interest from the sector at EU level (see also action E.7). Interactions of the project with different organizations and societies led to contacts being established with 6 main EU partners interested in hosting a visit from the project's partners:

- Partnership between the group Eurovia and the Muséum National d'Histoire Naturelle (France);
- Partnership between the group IMERYs and the Muséum National d'Histoire Naturelle (France);
- Partnership between the group HeidelbergCement and Birdlife (EU sites);
- Sister Federation of FEDIEX in Spain : Federacion de Aridos (Spain);
- Sister Federation of FEDIEX in Germany: Miro (Germany);
- Centre de Formation Raymond Bard and Office Français de la Biodiversité (OFB) Grand Est (France).

Preliminary discussions led to the visit of 7 sites in 3 countries either members of sister federations or part of the IMERYs group. The following sites were visited:

- Germany Visit of 2 members of MIRO (<https://www.miro-ka.de/>) :
 - 21/06/2021 : Frechen, Quarzwerke : Google position: <https://goo.gl/maps/dMTN8wegXi46Hk4E7>
 - Mergelstetten, Schwenk : Google position: <https://goo.gl/maps/DD9Gn5PGDNjbA7ST9>
 - 22/06/2021 : Rees, Holemans : Google positions: <https://goo.gl/maps/TFKaS8nb78rvCtNB6> & <https://goo.gl/maps/To5tWYRQu6uQn4rr8>
- France Visit of 2 IMERYs sites:
 - 23/11/2021 : Ploemur, IMERYs - Google Position: <https://goo.gl/maps/RiR7eRe3HPupugic9>
 - Précy sur Oise, IMERYs - Google Position: <https://goo.gl/maps/utF1fyEdojNu4Qis8>
- Spain – Visit of 2 members of Federacion de Aridos (<https://aridos.info/>):

- 9/11/2021 : La Falconera, PROMSA - Google position:
<https://goo.gl/maps/GprrhyU6e7vE9hnD6>
- 10/11/2021 : La Chanta, LafargeHolcim - Google position:
<https://goo.gl/maps/J2L9GptVMJzh1bds6>

While they did not conclude to site visits due to Covid constraints and project's timing limitation, interactions with (i) HeidelbergCement and Birdlife led to a collaboration in a Side event at the European Business & Nature Summit 2021; with (ii) Centre de Formation Raymond Bard led to an attendance to the Piloting committee allowing to exchange on temporary nature with OFB and to propose ways forward at the site level (see action E.7); and with, (iii) Eurovia could lead to future collaboration to develop a nature management platform for pilot sites in 2022 (see action D.4).

The visits all consisted in:

- The presentation of the hosting sites, exploitation plans, biological stakes identified through previous studies and actions previously implemented or expected over the long term;
- The presentation of the Life in Quarries project and the concept of temporary nature management;
- Exchanges on the policy implications and overlaps between existing actions and LIFE in Quarries actions;
- Sites visit targeting, in particular, active areas of the quarries and discussions on temporality of areas on site;
- Feedback in offices and pre-proposition of actions to implement;
- Feedback through a formal report including a list of actions proposed in the context of the sites
- Approval of the report and commitments for actions.

They were realized in the presence of local biologist/naturalists partners allowing for interactions on species present and confrontation of proposed actions to the species needs. All sites visits resulted interesting for both parties allowing to exchange on the feasibility of implementation, confront the project's actions to different species and climatic conditions.

Feedbacks from the different quarries were broadly positive with all 7 quarries committing to launch implementation and/or internal discussions for some of the temporary nature and/or permanent nature actions on their sites.

Limits identified included:

- **In Germany:** Questioning on legal implications of the temporary nature management as a law on temporary nature management was in discussion at the time of the visits. In the mean-time, it was proposed to implement the concept in progressive rehabilitation allowing to create habitats following exploitation in areas not expected to be impacted;
- **In Germany:** proposed grazing revealed interesting but lacked internal resources for implementation;
- **In Spain:** Climatic differences led to expected different biological responses of species with, e.g., amphibian species reproducing in the winter season leading to a need to adapt the timing of actions;
- **In Spain:** The site of La Chanta being closed for exploitation and in a phase of rehabilitation/restoration with a biodiversity objective accompanied by local NGOs, the temporary nature concept presented fewer potential for implementation;
- **In France:** the Ploemur site being currently under a permitting process including innovative temporary nature management, the LIFE in Quarries resulted in a refining of propositions made by the engineering consultancy.

"Your report is useful to us and the special emphasis on wetland biodiversity is striking....

... We also find it very interesting to carry out actions during the operation as learning from the professionals of the operation."

- Feedback from one of the visited Spanish quarry.



Figure 36. Discussion around a future set-aside pioneer pond expected to benefit the Iberian spadefoot toad (*Pelobates cultripes*) or Little ringed plovers in La Falconera, Spain (top left). Identification of an oligotrophic Chara pond in Pr cy sur Oise, France (top center), Pool hostin Yellow-bellied toad in Mergelstetten, Germany (top right). View from La Chanta rehabilitated quarry, Spain (bottom).

VI.1.D Action D - Monitoring of the impact of the project actions

D.1 Monitoring of tests and adaptation of techniques

Foreseen start date: July 2016

Actual start date: October 2016

Foreseen end date: December 2018

Actual end date: January 2020

The monitoring of test actions undertaken under C.1 through indicators developed in sub-action A2.a allowed adapting the implementation of actions C.2-C.3 (in Phase I) and C.4 (in Phase II).

Monitoring undertaken between 2016 and 2019 led to the delivery of three Synthetic reports.. Further delays compared to the schedule were linked to the extension of the monitoring to 2019 reducing the bias induced by the dry years of 2017 and 2018 as well as including more complete D.2 monitoring data in the monitoring of sub-action C.1a.

Detailed metrics of monitored actions are presented in Table 4 of action C.1.

a. **Dynamic management of temporary ponds**

The monitoring of the 81 ponds of actions C1.a showed that 50% of **runoff** water ponds were colonized by Stoneworts (*Chara sp.*) with little observations of target amphibians probably linked to cold waters. For **rainwater** ponds, this percentage reached only 13% while the colonization by Natterjack toads (on sites with known presence) reached a high value of 43% linked to warmer waters. 50% of the groundwater test ponds were colonized by Natterjack toads. No Midwife toads were observed in monitoring of test actions but could be observed afterwards in some sites. These numbers were encouraging as meant to increase over time. 21 ponds were discarded by the end of the monitoring period as they did not retain water or were part of the exploitation.



Figure 37. Juvenile of Natterjack toad observed in a test rain water pond at Clypot.

For practicability, the indicator of percentage of ponds holding water for more than a month was adapted to the percentage presenting water at the core of amphibians' presence, i.e., in June. It led to a total of c. 60 % of ponds holding water during the reproduction phase, i.e. considered as functional for the pioneer targeted species.

The outcomes of the monitoring allowed for the targeting of the most relevant ponds creation in actions C.2 and C.4. While *de novo* creations presented mixed success, the identification of spontaneous depressions accumulating water and presenting a biological interest (presence of amphibians' eggs, Chara/stoneworts ...) allowed extending the reach of action C.2a to their '*simple*' protection. Indeed, the success in creations has sometimes proven random while protection allows setting aside pre-existing ponds that could otherwise be impacted by daily activity. The discussions around the evolution of the indicator helped defining action D.4's ponds monitoring timing to allow presence of water information to be collected at the most relevant period for amphibians.

b. Dynamic management of associated pioneer grasslands

The monitoring of the 2.42 ha of pioneer grasslands (see action C.1b) was adapted as part of the Master thesis of Eva Cagnati⁹. Indeed, the percentage cover of vegetation after x years was irrelevant for set aside areas of various ages while low installation levels in 2017 linked to a dry year led to low percentage covers.

The Master thesis consisted in two main results:

- an analysis showing a diversification of vegetal communities linked to rocks' content of the substrate and a rapid colonization of silt and clay materials limiting the longevity of pioneer conditions;
- a further selection of species relevant for pioneer conditions as they present the highest germination rates on rocky substrates conditions;

On a side part, the master thesis allowed to determine that the sowing of linear pioneer grasslands was deemed difficult to monitor as: (i) the linear are much irregular in sizes, compositions, and status of vegetalization; (ii) narrow areas bordering tracks are regularly impacted during the maintenance as spoils are stored in these borders.

Outcomes lead to the realization of a decisional tree for the creation of pioneer grasslands that served as a basis for implementation of sub-action C.2b. The main stages include the identification of rocky pre-existing areas of interest presenting patrimonial species or potential new rocky areas outside of exploitation. Following setting aside, the choice of sowing can be made to enrich the area: with patrimonial and stonecrop species if the area is expected to be maintained on the longer term, or with ruderal species if not. The decision tree is presented in Figure 38.

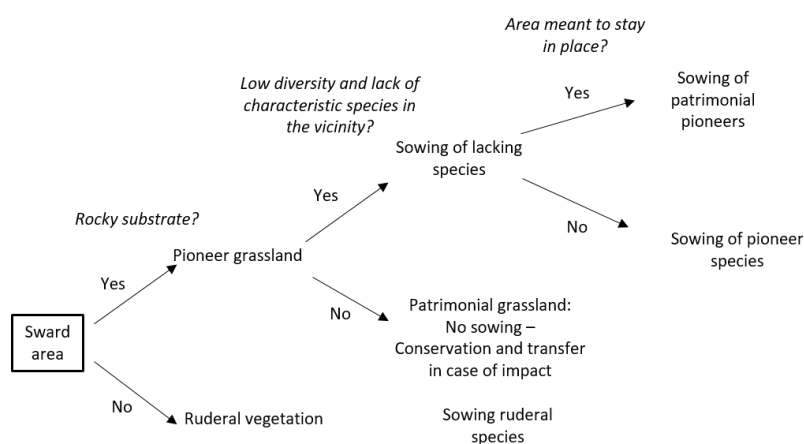


Figure 38. Decision tree for the sowing of pioneer grasslands.

c. Regular vertical face refreshment and creations

1. The 7 vertical faces were monitored for Sand martins' presence :

3 of the 5 vertical faces were colonized during the monitoring period. An additional one, the refreshed face of Carrières du Hainaut was colonized in 2021 (observation in action D.2). The exception was one of the two vertical faces at Frasnes, situated outside of the active area.

The outcomes of sub-action showed us that the creation of vertical faces in areas in which Sand martin colonies are known is likely advocating for the specific creation of stocks or the cutting of faces in action C.2 and C.4. Resulting less expensive, the latter solution is preferred.

⁹ Cagnati E. (2017) Evaluation de la qualité de différents substrats pour la création de pelouses pionnières fleuries analogues en carrières. Available at <http://hdl.handle.net/2268.2/3680>

2. All 3 sand banks monitored presented nesting aggregations of solitary bees leading to the action being further advocated on sites with sandy substrates. The creation of vertical faces even if not colonized by Sand martins demonstrated interesting for solitary bees.

d. Tests on scree creation and enrichment

Because no active scree were implemented (see under action A.1a and C.1d), the sub-action was not monitored.

e. Creation of shelters

As the monitoring of test shelters did not appear realistic to implement under the project, the 13 shelters were only monitored for their continued presence (*see however action D.2 for the monitoring of shelters under a Master Thesis in 2021*).

f. Collection of seeds for vascular plants species for seed lots

Out of the 23 populations launched, 6 had to be cancelled due to a lack of success in germination/production. This led to a total of 10 species (1 collected in the wild) in production representing 17 collected populations with one species (*Gentianella germanica*) unsuccessful in production.

Produced seeds were used in sowings under action C.2 to C.4. For 16 of the 17 populations 50 g of seeds were also stored long-term at the Botanical garden under a convention allowing them to benefit future restoration projects.

g. Translocation tests for *Bufo calamita* and h. *Triturus cristatus*

As no C.1g and C.1h intra-site translocation took place, these sub-actions were not monitored in D.1.

z. Actions under C.3

Monitoring of action C.3b – Creation of linear of bank favorable to reedbeds installation

170 m of mineral (hard rock) banks were adjusted with spoil earth to allow for reedbeds installation at Les Petons. While it was too early to conclude on outcomes, the banks being seasonally under water are expected to be colonized by reeds and/or amphibious vegetation in the mid-long term.

Monitoring of action C.3c – Placement of tern platforms

The two first tern platforms installed under action C.3c at Les Petons showed the presence of invasive Egyptian goose and were too low on water. The outcomes allowed adjusting future platforms to lift them higher from the water avoiding the wood to be damped and by reinforcing the wire fence to limit access to geese.

D.2 Monitoring of biodiversity and ecosystem functions restoration

Foreseen start date: April 2018

Actual start date: April 2018

Foreseen end date: September 2020

Actual end date: November 2021

Biological inventories undertaken under sub-action A.3a aimed at defining species and habitat at stakes in order to propose, under sub-action A.3b, relevant actions to be implemented through the implementation of management plans in concrete conservations action C.1 to C.4a. The objective of the biological monitoring was to evaluate the impact of actions on these species and habitats. The monitoring implemented on the 14 Phase I sites was based on biological indicators developed under sub-action A.2b and adapted in order to specifically monitor impacts of C.2 and C.3 actions effects on target species. An anonymized version of the final report was made available online allowing the sharing to a broader audience¹⁰.

In addition to mapping of habitats and to vegetations relevés within actions, the five main biological groups studied were the same as for inventories, i.e. Vascular plants, Birds, Reptiles, Amphibians and Dragonflies. They specifically aimed at determining functionality and use of actions by the list of target species.

Natagora and PNPE monitored the 14 Phase I quarries between March and September 2018 and 2020, for actions with limited numbers – i.e. C.2c, C.3b, C.3c, C.3d as well as sowing and translocations/reintroduction actions: C.2f to C.2i - outcomes of Phase II sites were integrated to improve the resolution level. Following encoding of c. 32 989 data observations on the regional official biological platform OFFH¹¹, monitoring were analyzed in an intermediary report edited in April 2020 and in a final report edited in its last version in November 2021 in close collaboration between Natagora, ULiège-GxABT and PNPE.

In addition to an intermediary and a final report analyzing the outcomes globally for the 14 Phase I quarries, 14 intermediary and 14 final individual monitoring reports were provided to Phase I quarries. While providing interesting outcomes at the site level, they allowed distinguishing actions deemed non-functional (dry ponds in particular) from functional ones, thus allowing supporting the update of action plans and finalization of management plans under D.5a.

The monitoring campaigns allowed objectifying functionality and biological impacts of the project's actions.

The **mapping** of habitats for the Phase I and Phase II quarries allowed monitoring the evolution of habitats over 5 years. Little evolution could be observed over the project, as areas will take time to evolve, through management, towards the desired habitats. However, two **projections 'with' or 'without' project's actions** implementation led to identify expected evolutions in the surfaces of grasslands (Wal-Eunis habitat E) linked to a diminution of Weed communities (E5.6) to the benefit of calcareous grasslands (E1.2), dry acid and neutral open grasslands (E1.9), hay meadows (E2.2). To these areas, the commitment to maintain 25.1 ha of dynamically managed pioneer grasslands will further add to these grassland habitat of important patrimonial value. We can also expect an evolution in the future with new areas progressively restored into grasslands as a result of the increased sector's consciousness.

The analysis of all 187 inventories and 574 monitoring **vegetation relevés** led to identify 3 vegetation groups corresponding to aquatic, semi-aquatic and terrestrial vegetations. Indicator species for each group were determined. This analysis showed the similarity in aquatic vegetation of permanent ponds' with that of pioneer ponds in first colonization stages.

A specific analysis of **446 aquatic relevés** led to identify a large heterogeneity in vegetations from oligotrophic ponds with Stoneworts (*Chara sp.*) to macrophytes dominated ones. Within the 7 groups the analysis further helped distinguish between aquatic vegetations and dry ponds, i.e. non-functionnal for aquatic vegetation.

Another specific analysis of terrestrial habitats included **315 grasslands relevés** from pioneer, grazed and mowed vegetations and linear screes. It allowed showing, rather than clearly distinct groups, a *continuum* between pioneer grasslands and hay meadows that can result, on site, in difficulties to distinguish pioneer

¹⁰ Available at <http://hdl.handle.net/2268/266063>

¹¹ <http://observatoire.biodiversite.wallonie.be/encodage/>

grasslands from grazed ones except by taking into account their management. Three vegetation groups could however be identified along with their indicator species.

The monitoring of **temporary nature** enabled to point out:

a. Dynamic management of temporary ponds

165 functional (i.e. in water over 2 successives, 1 month apart, monitoring in the spring/summer season) pioneer ponds (C2.a) among the 366 monitored in Phase I quarries demonstrating the difficulty to maintain water, even in areas judged favorable. The 4 dry years leading to 2020 can at least explain part of this mixed success. A precautionary stance led to discard non-functional ponds prior to the finalization of management plans (action D.5).

Within sites with occurrence of target species, the 165 ponds were monitored for presence within the action. It led to promising results by identifying 44.1%, 32.3% and 21.7% of ponds respectively hosting Stoneworts (*Chara sp.*), Natterjack (*Bufo calamita*) and Midwife (*Alytes obstetricans*) toads.

Within target dragonflies, the Southern skimmer (*Orthetrum brunneum*) was present in 40% of monitored functional ponds from sites with occurrences. The Keeled skimmer (*Orthetrum coerulescens* - 29 %), the Blue-tailed damselfly (*Ischnura pumilio* - 17 %) and the Winter damselfly (*Sympecma fusca* - 10 %) presented lower responses.



Figure 39. Stoneworts (*Chara sp.*) in a newly colonized pioneer pond of Calcaires de la Sambre.

b. Dynamic management of associated pioneer grasslands

11.92 ha of monitored pioneer grasslands (C2.b) hosted 18 target plant species with some such as the Stinking hawksbeard (*Crepis foetida*) and the Common centaury (*Centaureum erythraea*) presenting a true ability to colonize new areas. Part of the sown species (under sub-action C.2f) presented thriving populations in the first years following introduction. This is the case for the Red hemp-nettle (*Galeopsis angustifolia*), the Proliferous childing-pink (*Petrorhagia prolifera*) and the Deptford pink (*Dianthus armeria*). A diversity of patrimonial species not targeted by the project could also be observed.

As for fauna, 18% pioneer grasslands presented proofs of Little-ringed plover occupation (*Charadrius dubius*). Natterjack (*Bufo calamita*) and Midwife (*Alytes obstetricans*) toads also regularly used them as well as the Common wall lizard (*Podarcis muralis*) (observed in 83 % of grasslands of sites with occurrence).



Figure 40. Little ringed plover presence in pioneer grasslands of Sablières Lannoy and nest and eggs present within a project's set aside area in Jemelle.

c. Regular vertical face refreshment and creations

13 **Vertical faces (C.2c)** were monitored. Within them, 9 were occupied by Sand martins (*Riparia riparia*);

All 13 **Sand banks (C.2c)** monitored were occupied by solitary bees nest aggregations among which the patrimonial Spring mining bee (*Colletes cunicularius*);



Figure 41. Sand martins (here at Les Petons) and Spring mining bee occurred in Vertical faces and Sand banks of the project.

e. Annual creation of shelters

112 Shelters (C.2e) were specifically monitored for Natterjack (*Bufo calamita*) and Midwife (*Alytes obstetricans*) toads under the master thesis of Aurélie Tock at ULiège-GxABT¹². The presence of both species and newts in newly built shelters demonstrate their usage of hides provided.



Figure 42. Monitoring of shelters for amphibians went through the overnight trapping of amphibians exiting them (here at Frasnes).

¹² Available from end of academic year 2021-2022 at <https://matheo.uliege.be>

f. Development of vascular plant species

11 species were sown with patrimonial pioneer plants in 62 parcels of 21 quarries. The master thesis of Johan Jacob (ULiège-GxABT)¹³ studied 47 of those parcels in 18 quarries sown in 2019. It allowed identifying **10 out of the 11 species occurring** in these parcels. Out of 58 populations sown, 42 could be observed in 2020.



Figure 43. Newly installed populations of the Red hemp-nettle (*Galeopsis angustifolia*) (Trooz – left) and of the Proliferous childing-pink (*Petrorhagia prolifera*) (Les Petons - right).

Table 11. Number of sites sown for each species of Lot 1 and number of sites where at least one population could be identified in 2020 (for sites until spring 2019).

	Erythrée petite centaaurée (<i>Centaurium erythraea</i>)	Œillet velu (<i>Dianthus armeria</i>)	Cotonière allemande (<i>Filago vULiègeensis</i>)	Galeopsis à feuilles étroites (<i>Galeopsis angustifolia</i>)	Gentiane d'Allemagne (<i>Gentiana germanica</i>)	Jasione des montagnes (<i>Jasione montana</i>)	Gesse sans feuilles (<i>Lathyrus aphaca</i>)	Gesse hérissée (<i>Lathyrus hirsutus</i>)	Œillet prolifère (<i>Petrorhagia prolifera</i>)	Silène de France (<i>Silene gallica</i>)	Faux Bouillon-blanc (<i>Verbascum densiflorum</i>)
Number of sites where the species was sown	1(+1)	11(+1)	3(+2)	5	1	1	1	7	14	1(+2)	13
Number of sites where the species was observed	1	5	3	5	0	0	1	6	14	1	6

(+): Additional numbers of sown sites after 2019.

g. Translocations of *Bufo calamita*, h. of *Triturus cristatus* and i. Breeding of *Bombina variegata*

The monitoring of amphibians translocations (C.2g and h) and reintroductions (C.3i) allowed confirming the progressive installation of:

- 5 new populations of Natterjack toad (*Bufo calamita*) with proofs of reproduction and evaluation of the number of adult individuals on 3 sites through Aurore Deflandre's master thesis (ULiège-GxABT)¹⁴;
- 4 new populations of Great crested newts (*Triturus cristatus*) with juveniles and sub-adults observed 2 years after first translocations;
- 1 new population of Yellow-bellied toad (*Bombina variegata*) with sub-adults observed the year following reintroduction.

¹³ Available at <http://hdl.handle.net/2268.2/11125>

¹⁴ Available at <http://hdl.handle.net/2268.2/13237>



Figure 44. Reproducing adults of Natterjack toad and sub-adults of Yellow-bellied toad and Great crested newt observed in 2020 and 2021 in newly established populations at Hermalle, Warche and Bierghes.

Permanent nature actions were also monitored. Outcomes allowed identifying:

a. **Creation of permanent ponds >25m²**

61 functional (presenting water the 31st of may) permanent ponds (C.3a) from the 103 monitored. These 61 ponds proved rapidly colonized by target species among which pioneer ones in early years following their creation. Among target species, the newts rapidly colonized the ponds with the Common newt (*Lissotriton vulgaris*) present in 70.8 % of functional ponds within its sites of occurrence, followed by the Alpine (*Ichthyosaura alpestris*), and the Palmate newt (*Lissotriton helveticus*), respectively occurring in 56.1 % and 52.2 %. The Great crested newt (*Triturus cristatus*) could also be observed in newly dug ponds (4 of 15 functional ponds surveyed in 2 sites, this number is likely an underestimation as not all ponds could be inventoried).



Figure 45. Monitored pond with continuous presence of Great crested newt between 2016 and 2020 at Hermalle.

b. Creation of linear of bank favourable to reedbeds installation

618 m of linear banks (C3.b) favorable to reedbeds were monitored solely on a structural basis;

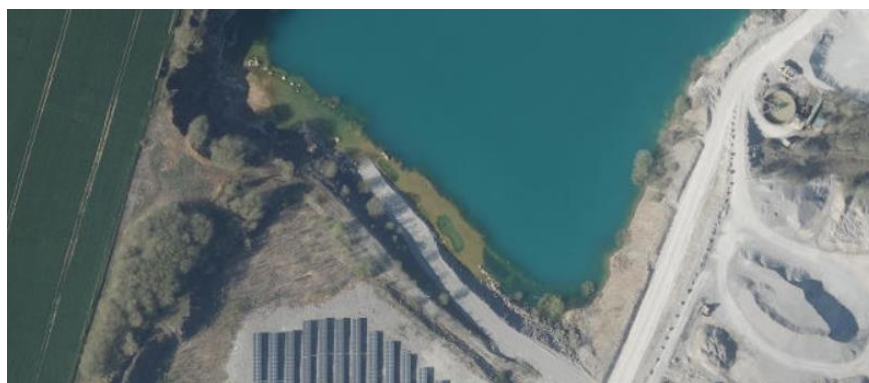


Figure 46. Aerial view of the banks at Les Petons in 2021 showing the presence of water covering the newly installed overburden material.

c. Placement of tern platforms

8 tern and **10 Common gull platform** as well as **1 islet (C3.c)** were monitored. While 1 platform saw the observation of a Midwife toad, no target bird could be observed as nesting but for a Little grebe (*Tachybaptus ruficollis*) on the islet.

d. Securing of chiropters galleries

1/3 of the **11 Chiropters galleries (C.3d)** secured over 9 quarries hosted 8 species of bats.



Figure 47. Use of micro-hides by Whiskered bat (*Myotis mystacinus/brandtii*) and Brown long-eared bat (*Plecotus auritus*) in secured galleries.

e. Restoration and management of mowed grasslands, and f. Restoration and management of grazed grasslands

See the analysis of **vegetation relevés** (cf. supra).

h. Creation of linear screens

2126 m of linear screens (C.3h) were mainly monitored from a structural point of view.

Delays on the foreseen delivery dates were linked to the good season of 2019 being used to launch translocation and reintroduction actions and redaction being postponed to the winter period. In 2021, the delays allowed integrating original student researches results on the use of shelters by amphibians (C.2d), on translocations of Natterjack toads (C.2g) as well as on outcomes of patrimonial species sowing (C.2f). It also led to the inclusion of complete data on amphibians' translocations and reintroduction sub-actions C.2g to C.2i. Finally, the extra time allowed for in depth analyses of 761 vegetations relevés providing important insights into vegetal communities encountered in ponds (C.2a and C.3a) and in grasslands (C.2b, C.3e and C.3f) that will serve as a solid basis for future monitoring and researches.

The outcomes of the actions allowed for a final evaluation of the success of management actions on biological groups and ecosystem services. Developed in parallel with action D.5 as first outcomes were available as of 2020 this step was a key input to finalize the long-term management plans (D.5) and to demonstrate the biological efficiency and compatibility of proposed biodiversity management actions with exploitation process, notably during the sites visits undertaken with the public administration (DNF) in the presentation of management plans.

D.3 Monitoring of Ecosystem Services

Foreseen start date: April 2018

Actual start date: April 2018

Foreseen end date: September 2020

Actual end date: December 2021

While the initial Ecosystem Services (ES) situation was evaluated for all participating sites under action A.6, these services were expected to evolve due to implementation of actions C.2 to C.4a. Action D.3 thus originally aimed at evaluating the dynamic of ES in quarries during the realizations of temporary (C.2) and permanent (C.3) nature management actions.

The evolution was originally to be evaluated for all Phase I quarries in 2018 and for all project's quarries in 2020.

Intermediary evaluation

For the 2018 evaluation, the following assumptions were reported under the 2018 progress report:

- While C.2 sub-actions, by increasing site's biodiversity, can have a strong impact on the cultural services provided by the quarries, in particular the service "Natural areas and biodiversity, sources of intrinsic values of existence and heritage", but were expected to have a limited impact on production and regulatory services, as they did not imply a significant change in land use.
- On the other hand, C.3 sub-actions affected larger areas by modifying their land use or management so that they were expected to have a deeper impact on production and regulatory services, but also on cultural services, as they help develop the biodiversity of quarry sites.

These assumptions were coherent with the project description that anticipated that optimized restoration actions (under C.3) in the post-exploitation phase could contribute to more ES restoration while the C.2 actions, could even contribute to ES by promoting pioneer habitats and fugitive biodiversity.

However as: (i) the timing of impact on ES being highly dependent on implementation of actions C.2 and C.3, and, (ii) until 2018 Phase I sites were mainly devoted to the implementation of some of the temporary sub-action C.2, sub-actions C.3 needing more preparation and mainly implemented between 2019 and 2021; it appeared inappropriate to monitor all sites so that the following procedure was proposed for the **intermediate ES monitoring**.

In order to compare the results obtained, it was proposed to focus the monitoring of the **regulation and production services** on:

- Two quarries that had already implemented C.3 actions over large areas; and
- Two quarries that had not yet realized significant C.3 actions.

Cultural services evaluation would be carried on all Phase I sites.

While the strategy was expected to demonstrate the effect of the LIFE in Quarries actions, it appeared from the intermediary report that the evolution of production and regulation was limited. Indeed, the habitats' classification of the areas covered by C.3 actions while evolving did not do so significantly as priority was given to enhance habitat quality rather than to transform them from exploited areas to pristine patrimonial habitats. It instead appeared that the provision of services could be related to the evolution of quarries through their entire life-cycle, which the LIFE in Quarries only represented a small time fraction in exploitation.

Subsequently the final deliverable was adapted to concentrate on the evaluation of ES dynamic in active quarries in relation to the implementation of C.2 and C.3 actions at the project level rather than for each site individually.

Final evaluation “Ecosystem services assessment in the Extractive sector LESSONS from the LIFE IN QUARRIES PROJECT”

The methodology applied under action A.6 was applied at the project’s level first to **compare provisioning, regulating and cultural ES (Figure 48) stocks, flows and demands** between 2016 and 2020 to assess the **Diversity of Ecosystem Services provided by project’s quarries**.

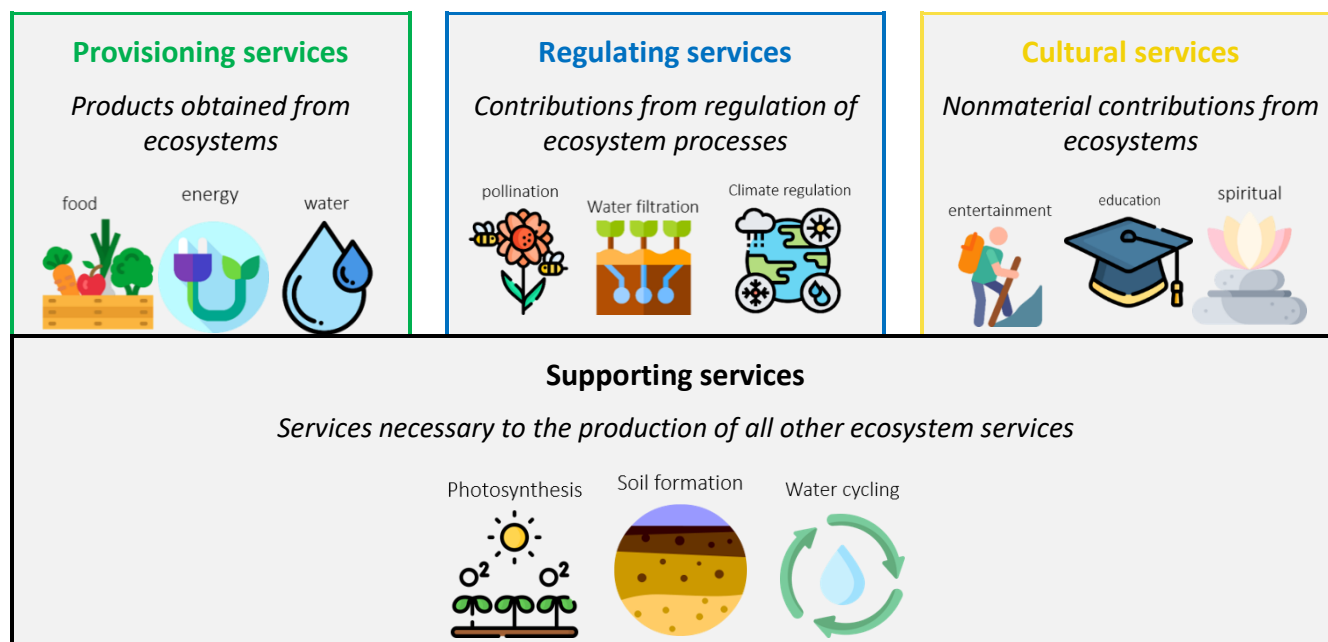


Figure 48. MEA classification of ecosystem services (Inspired from Millennium Ecosystem Assessment, 2005).

It was followed by an evaluation of the **Impact of LIFE in Quarries biodiversity actions (i.e. C.2 to C.4a) on Ecosystem Services** that assessed changes in estimated stocks and flows of provisioning and regulating services under a 15 years **projections ‘with’ or ‘without’ project’s actions** as realized for habitats’ evolutions under action D.2. The difference between the ‘without’ and the ‘with’ scenarios could be related to the project implementation:

- **Provisioning services** mainly impacted by the project were the ‘fodder’ and ‘commercial and non-commercial breeding’, with impacts linked to the creation of permanent grasslands and meadows and thus the creation of permanent habitats (under C.3 and equivalent in C.4a).
- For most **Regulating services**, the project’s actions resulted in an additional marginal diminution as compared to an estimated situation without actions. Within this category, a low impact on the service ‘Maintenance of habitats for species life-cycle’ could be related to the fact that method used did not reflect the actual impact of actions on biodiversity as:
 - (i) Areas with high service’s scores for permanent habitats (i.e. *Broadleaved deciduous woodland* – G1, score 5), were replaced by other high scored habitats (*Dry grasslands* – E1, score 4, and, *Mesic grasslands* – E2, score 5), resulting in a similar global score. This scoring does not reflect the gain of biodiversity resulting from the transition from secondary forests with moderate biodiversity potential to highly diversified grasslands;
 - (ii) Second, LIFE in Quarries actions were in priority dedicated to promote temporary pioneer habitats, typically of small surfaces (hence with low influence the weighted ES scoring) but with high additional value for threatened and protected associated species.
- The percentage of quarries contributing to **Cultural services** increased, despite the Covid-19 crisis lockdown at the end of the project (2020-2021). This was mainly linked to new activities brought by the project allowing the flow of services to be provided. The largest increase was observed for ‘Biodiversity as source of intrinsic values of existence and heritage’ (+91%) as a result of the values attributed to biodiversity in quarries and the adoption of ambitious

actions plans promoting biodiversity. The second largest increase was observed for cultural services linked to direct experience of biodiversity and nature: *‘Natural space and biodiversity supporting the experience of nature and natural space’* and *‘Biodiversity sources of intrinsic values of existence and heritage’* (see also action D.6).

To summarize the outcomes of the analysis, an evaluation of the **Evolution of Ecosystem Services through the life cycle of a quarry** was realized. It assessed, in general, how ecosystem services evolve through a quarry’s life cycle. To do so, quarries were classified in four theoretical groups of exploitation stage (Figure 49).

The 2016 data served as a basis to study classical trends in the evolution of **provisioning** and **regulating services** stocks over the life stages of a quarry. The assessment demonstrated that ES stocks change over a quarry life cycle in relation to land use and ecosystems modifications. This was particularly true for **regulating services** with a global decrease for quarries progressing in their exploitation stages, as compared to quarries in their initial or more advanced exploitation stages. **Provisioning services** also evolve along with the evolution of available areas for agriculture and other production activities in the perimeter of the quarries. This means that **evaluations of ES management in quarries need to be framed in adequate and evolving repositories that consider the local environment and the exploitation stages.**

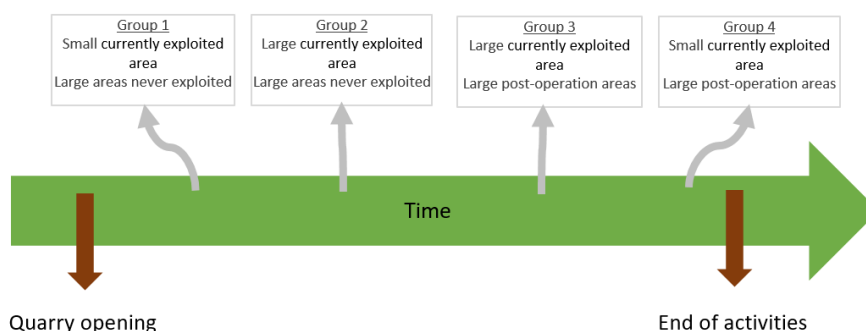


Figure 49. Schematic representation of the different groups of quarries representing different exploitation stages of an extractive site.

As a conclusion, the assessment demonstrated that active quarries can support a diversity of **provisioning, regulating** and **cultural services** stocks. This potential for multiple services is linked to the diversity of ecosystems present in active extraction sites.

Quarries can thus contribute to the development of Green/Blue Infrastructure especially in highly anthropogenic, homogenized landscapes. They can indeed act as important places for the **regulating service** *‘Maintenance of habitats for species life cycles’*, as stepping stones for species with high dispersal capacity (dragonflies, pollinators, bats, birds) or even core habitats for populations of less mobile species (e.g. amphibians). In this context, quarries can bring an interesting contribution **to the connectivity of Natura 2000 Network outside N2000 sites.**

Through their ecosystemic diversity, **quarries can diversify the offer of provisioning services in homogeneous landscapes:** *‘Commercial crops’* and *‘breeding’* production in non-exploited and restored areas.

The importance of **cultural services** highlighted in this assessment supported the fact that **quarries are also opportunities to connect people to nature** in biologically impoverished landscapes by increasing ES related to *‘Sources of experience and knowledge’* and *‘Natural space and biodiversity sources of intrinsic values of existence and heritage’*.

D.4 Basic monitoring

Foreseen start date: April 2017

Actual start date: April 2017

Foreseen end date: September 2020

Actual end date: December 2021

The implementation of a dynamic management of temporary nature (under action D.5) makes an autonomous annual monitoring essential to anticipate habitats creation necessary to maintain the management plan's objectives (number/surfaces of habitat). This led to the development of a 'Basic monitoring' in action D.4.

The implementation of the action started by the definition of a first set of indicators to assess the success of the actions under sub-action A.2d. A list, resulting from a 2017-2018 students' work at ULiège-GxABT, was first presented as part of the training session organized for quarry and biodiversity responsible, in May/June 2018 (see sub-action E.5a). The goal was to discuss the envisaged procedure and coach quarry managers on its implementation. For each action, indicators consisted of both structural (i.e. physical parameters) and biological (i.e. target species) indicators categorized either as mandatory or optional. The list was presented for implementation on Phase I site along with naturalist partners. It was tested in Natagora's Phase I quarries and feedbacks collected.

These feedbacks revealed that the means (consisting in simple sheets gathering all basic information needed to adequately evaluate the success of C.2 sub-actions) proved **inconvenient in implementation**. In addition, the list of indicators was not always understood and relevance questioned. It appeared obvious that the basic monitoring should be **simple** and **easy** to implement for non-naturalists to ensure the **long-term** application and adequate to appraise the habitat's **functionality** for the targeted species.

Development of the AMBREs platform

To meet these demands, it was thus proposed to develop a **specific integrated tool** for the LIFE in Quarries project to respond to specific needs:

- **Data storage:** ensuring that the baseline and monitoring data, resulting from action A.3a and D.2), were available for quarries in an user friendly way as opposed to the regional public portal adapted to naturalist use: OFFH. The newly developed portal would include all data from inventories (A.3aa) and monitoring (D.2) in a geographic user-friendly environment.
- **Geographical portal** allowing a dynamic follow-up of the actions implemented on the quarry site useful for the long-term follow-up and monitoring as the quarries are dynamic environments with a fast evolution.
- **Integrated system** with a restricted access to individual quarry company, and at a supervisor level.

The system planned on integrating a:

- Production of annual reporting per site based on a common template;
- Automatic reminders for specific deadline imposed by the monitoring protocols ...

Upon evaluation of cost and the justification of the benefit to develop the tool internally by ULiège's personnel - benefiting from previous experience of developing a similar tool for a mining company in DR Congo (www.copperflora.org):

- **2019:** The development was launched beginning of 2019. The development was taken in charge by Sylvain Boisson from ULiège-GxABT. Following the adjustment of indicators, and first development of the online "AMBREs" (previously GDB-LiQ) platform, its beta version was tested in 2019 on all sites by quarry staff accompanied with ULiège-GxABT. Positive feedbacks from most quarry personnel confirmed the benefit of the tool. Outcomes allowed identifying caveats and further develop the platform over the course of 2019 and beginning of 2020 along with the help of Lilly Gillet.;



Figure 50. Implementation of the Basi monitoring by quarry personnel and first tests of the AMBREs platform at Jemelle, Baileux and Milieu (top, from left to right). Exchanges on fonctionnalités with the webmaster at Clypot (bottom).

- **2020:** While it was expected to train in 2 on-site sessions all quarry partners to allow for further appropriation of a first finalized version of the platform, due to Covid-19, the second training had to be re-oriented towards an online training with the development of specific video capsules as support. Autonomous implementation was left to quarry personnel. This first year in total autonomy on the use of the platform was positive with an estimated usage rate of 80%.
- **2021:** The year 2021 saw some adjustments in the indicators/questions in order to allow a match between the monitoring expected under management plans and the outcomes of the AMBREs monitoring. A 100% completion of the monitoring autonomously with a helpdesk provided insure that all quarries are now adequately trained and appropriated the tool. The year also led to the definition of a common template for the reporting on the status of both temporary and permanent nature towards the regional authority (DNF) allowing to follow commitment of the management plans and secure the associated annual report. The automatic reminders were defined and launched in the end of 2021;

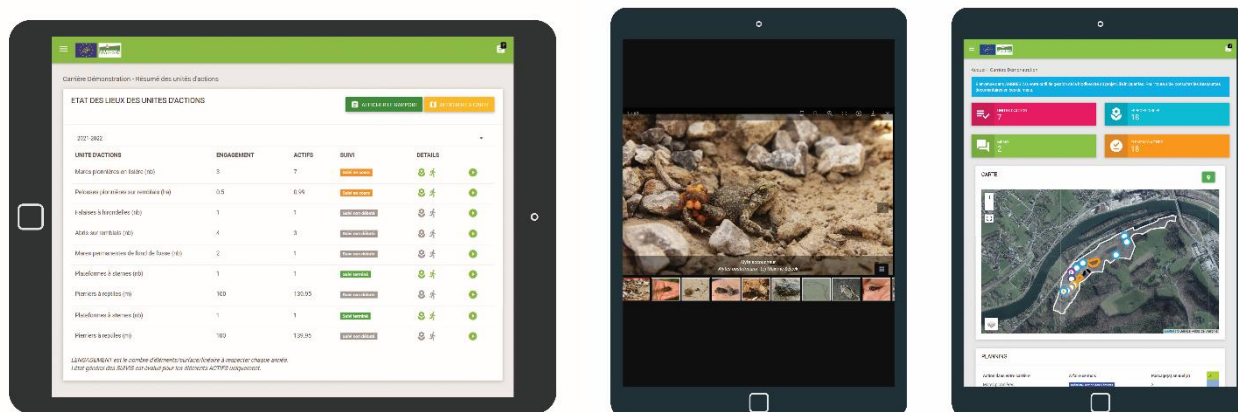


Figure 51. Some fonctionnalités of the AMBREs platform: indicators menu presenting commitments and monitoring status for the year, species pictures database, interactive map of elements of temporary and permanent nature present.

- **2022 and After-LIFE:** To ensure the long-term viability of the platform, an agreement between FEDIEX and ULiège-GxABT to maintain and manage the platform was signed. It considers, among others, the

possibility to create new sites allowing new quarries to join the LIFE in Quarries process in the After-LIFE (F.3).

The development of AMBREs has conducted to interest abroad with developments of similar tools underway as part of a new collaboration between ULiège-GxABT and IMERYs.

The platform can be accessed online on smartphones or tablets as well as in the office. Through a cartographic tool, quarries can identify actions in place (Figure 51) and easily create new actions or discard old ones. The annual monitoring takes the form of a questionnaire with mandatory (structure) and optional (species) questions. Target species distributions from the inventories and project's monitoring are easily accessible allowing identifying best areas for action. It also acts as a technical resources depository where the main documents related to each site and produced over the project is made available allowing a unique access to important deliverables. An indicators menu allow identifying, at a glance, active realizations to commitments as well as monitoring status (Figure 51).

The main functionalities of the platform were presented as part of the EU Working Group (action E.7) in December 2021. Its philosophy is also included in a specific short chapter of the methodological guide (under sub-action E.5c).

Technical problems / delays: The unforeseen development of the integrated monitoring extended the initial deadline of the basic monitoring action. Indeed, the initial D.4 trainings rapidly showed the need of a user-friendly and cartographic tool as key element for better sustainability on the long-term.

D.5 Management plan update

Foreseen start date: August 2017

Actual start date: October 2017

Foreseen end date: December 2019

Actual end date: December 2021

The strategy, resulting from action A.4, to develop viable and legally valid management plans on the long-term (After-LIFE, F.3) includes three main documents:

- **Biodiversity management plans** resulting from regular updates of site-specific action plans. The final documents contain all committed and implemented action units to be maintained and managed in accordance to set criteria. This document is the masterpiece of the After-LIFE plan with long-term commitment of the quarry operators under the charter and legally guaranteed by specific derogation.
- **Derogations** to the Nature Conservation Law are required to allow the implementation of concrete conservation management dealing with protected species. Site-specific derogations were requested for the management of actions favoring the long-term maintenance of targeted species.
- **Commitment charters**: a proposal was submitted and reviewed by the regional authority to maintain the long-term application of the project initiative. This charter is formalizing the continuous execution of the biodiversity management plan for at least 15 years.

Two first documents are further presented under sub-action D.5a, the charters are part of sub-action D.5b.

a. **Regular update of temporary nature action plan**

The initial action plans, proposed under action A3.b, were considered as a set of feasible actions whose operational implementation or functional success had to be verified on site. The project team member accompanied quarry managers in this implementation through regular updates. Originally planned on a yearly basis, the frequency of updates was adapted in accordance with the sites' need and upon realizations. Over a period of 2 to 4 years, frequent states of play allowed identifying actions to be discarded as they resulted non relevant as well as new opportunities for implementation with an objective to work towards an operational and successful **management plan** to be continued in the framework of the After-LIFE charters (under sub-action D.5b and action F.3).

In 2019, following main actions C.2 to C.3 implementation on the first sites and outcomes of the legal analysis (resulting from action A.4a), the project team worked on defining management plans. Its structure was built by ULiège-GxABT with a cross-validation and evolutions brought by all partners. It was based on the definition of **minimal commitments for each C.2 and C.3 sub-actions to ensure the long-term viability of target species populations**.

The philosophy was adapted in an iterative process with two pilot quarries (Carrière du Clypot – CCB, Carrière de Steinbach – Trageco). The process led in close collaboration between FEDIEX and ULiège-GxABT involved:

- The public administration (DNF central) to define a global approach compatible with derogation under the regional Nature Conservation Law and its equivalent of EU Habitats Directive Article 16;
- Natagora and PNPE to ensure adequation of required commitments with species needs;
- Quarry manager and environmental responsible to ensure that proposed commitments were realistic and that initial minimal requirements were met prior to the finalization of management plans;
- The public administration (DNF local) to handle the management plans and challenge their content at site level.

The outcomes of both management plans development helped define a general management plan canvas including rules for minimal commitments to be applied to the 24 other quarries in the first semester of 2020.

The validation of 26 individual biodiversity management plans for each participating quarries was the focus of the year 2020 with last actions implemented to reach accepted minimal requirements over 2020 and 2021. Figures on surfaces, linear and numbers committed and in place upon finalization of management plans are detailed in Table 5, Table 8 and Table 10 under C.2 to C4.a actions. They are summarized hereafter in Table 12 with all implemented actions presented.

Table 12. Synthesis of C.2 to C.4a realized and committed project quarries as of the finalization of management plans

	C.2a (n)	C.2b (ha)	C.2c – Sand martins (n)	C.2c – Solitary bees (n)	C.2d (ha)	C.2e (n)	C.2f (n)	C.2g (n)	C.2h (n)	C.2i (n)	C.3a (n)	C.3b (m)	C.3c – Terms (n)	C.3c – Common gull (n)	C.3c – Islet (n)	C.3d (n)	C.3e (ha)	C.3f (ha)	C.3g (m)	C.3h (m)
<i>Global objectives</i>	120	12	10	-	5	96	8	4	4	1	24	400	16	-	-	4	10	50	-	8000
<i>Elements in place (Commitment) – Phase I sites</i>	204 (150)	14.69 (11.15)	9 (8)	9 (6)	- (-)	184 (160)	/	3	2	-	87 (72)	605 (560)	6 (6)	13 (10)	1 (1)	8 (8)	13.66 (13.35)	33.96 (30.75)	- (-)	3744 (3450)
<i>Elements in place (Commitment) – Phase II sites</i>	199 (150)	16.06 (13.95)	5 (3)	9 (8)	- (-)	219 (170)	/	2	2	1	56 (47)	77 (70)	2 (2)	9 (9)	-	4 (4)	15.88 (14.75)	44.67 (44.35)	- (-)	1693 (1600)
<i>Total LIFE in Quarries</i>	403 (300)	30.75 (25.1)	14 (11)	18 (14)	- (-)	403 (330)	10	5	4	1	143 (119)	682 (630)	8 (8)	22 (19)	1 (1)	12 (12)	29.54 (28.1)	78.63 (75.1)	- (-)	5437 (5050)
<i>Commitment/objective (%)</i>	250%	209.2%	110%	/	/	343.8%	125%	125%	100%	100%	495.8%	157.5%	50%	/	/	300%	281%	150.2%	0%	63.1%

Following the submission and approval of both pilot quarries derogation requests by the regional authority at the end of 2020, two canvas for the derogation procedure were developed and adapted to the 24 remaining quarries in the course of 2021 with 23 additional derogation requests submitted in June (21) and September (2) and granted in December 2021.

Delays between the finalization of management plans and the submission of derogation requests were mainly linked to the time necessary for the finalization of permanent actions including fencing of grazed grasslands (sub-action C.3f and equivalent in C.4a) and deforestation (C.3e and C.3f and C.4a equivalent). The last (Lustin) derogation request and associated management plan was submitted in February 2022 upon realization of a linear scree linked to the permitting procedure associated to the building of an observation platform (see sub-action E.6b).

The management plans thus aim at maintaining the objectives in surface, linear and numbers committed for C.2 sub-actions and equivalents in C.4a. These figures are not spatially fixed but need to be moved to ensure the long-term maintenance of pioneer conditions. On the other hand, C.3 and C.4a sub-actions are committed to be maintained over the long-term except for force majeure case that would then need to be discussed with the DNF and compensated (see details in introduction to permanent nature actions in the management plan canvas). The non-respect of management plan would likely lead to derogation being considered null and void.

Annual and 5-year monitoring (see After-LIFE, F.3) will allow following the continuous implementation. The development of a Terms of Reference for call to experts defines the expected studies and outcomes.

b. Redaction and signature of charters

The 2 pilot charters have been signed on 27/10/2021 at the final conference of the project. The 23 others have been signed on 06/01/2022. A slight delay was linked to the Christmas holidays.

The last charter (Lustin) will be signed upon approval of the derogation. Expected timeframe is end of Q2 2022, depending on the administration and the Minister for respectively the derogation and signature of the charter.

See action A.4c for more background information on the charters.

D.6 Socio-cultural monitoring of communication actions / consciousness of the sector for biodiversity

Foreseen start date: January 2016
Foreseen end date: September 2020

Actual start date: December 2015
Actual end date: December 2021

Sub-actions D.6a and D.6b aimed at evaluating the initial and final perception of the quarry sector on biodiversity in order to assess how the project has changed behaviors and motivations as well as to reveal lock-ins and identify potential ways around for the benefit of the project.

Sub-action D.6c was designed to estimate the extra cost related to the management of biodiversity in quarries.

a. Initial Consciousness

The methodology and the questionnaire for the initial survey were built from December 2015 to April 2016 by ULiège-GxABT along with the development of indicators under sub-action A.2e. Questions were based on a literature review of scientific papers and reports studying biodiversity awareness and nature or environmental issues in various economic sectors. The first survey to evaluate the consciousness of the sector for biodiversity was conducted between May and July 2016 through **102 face to face interviews** in the 14 Phase I sites, 10 sites then foreseen to take part in Phase II and 7 Walloon sites not members of FEDIEX. Interviews targeted the different level of responsibilities, from workers to site managers.

Results of the initial survey led to an initial on awareness. Main outcomes included (i) a wide variability in biodiversity knowledge among sites and hierarchical positions and (ii) concerns about the constraints that biodiversity could bring to the extractive activities and the safety on sites.

b. Final Consciousness

The final survey aimed at allowing a comparison in the knowledge and consciousness evolution linked to the project. The interviews process was implemented again after the addition of three new sections to the 2021 questionnaire. These new sections aimed at specifically evaluating the impact of the LIFE in Quarries Actions Extra costs related to the management of biodiversity in quarries. 99 interviews were conducted in a mix of face-to-face and videoconference interviews (due to the Covid-19 crisis), from March to May 2021.

Results were part of a final report¹⁵ and main outcomes indicated that:

- The **knowledge on the concept of biodiversity and target species and habitats** both increased over the project. This was accompanied by an evolution in the perception of important areas for biodiversity in quarries with active areas broadly identified in 2021 as supporting biodiversity to the contrary of the initial interviews;
- The value and importance attributed to biodiversity, while high at the beginning of the project, increased over the project as did the willingness to protect biodiversity in the working place;
- Relationship to biodiversity increased favorably for 75 % of LIFE in Quarries participants (Figure 52);

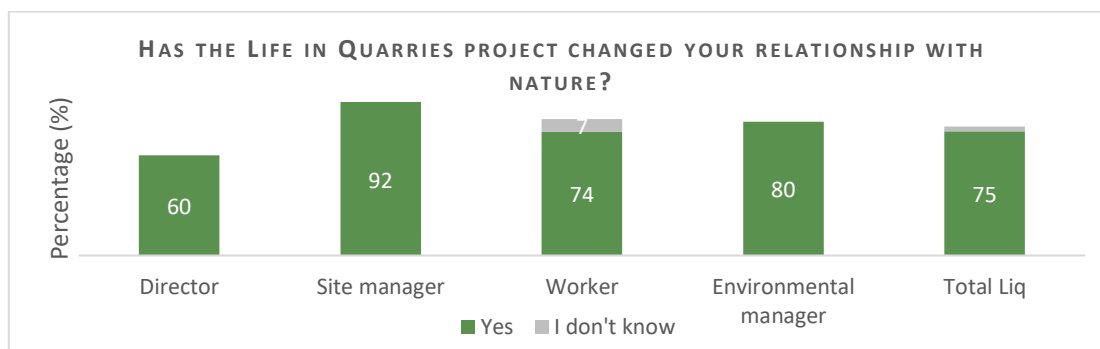


Figure 52. Percentage of respondents for whom the LIFE in Quarries project changed their relationship with nature depending on their position in the company. Results from respondents of the LIFE in Quarries sites.

¹⁵ Available at : <http://hdl.handle.net/2268/266146>

- Even though biodiversity management was more perceived as a constraint by the extractive sector in 2021 as a result of the need to plan actions in accordance with the life cycle of species, the **perception of biodiversity as an opportunity than as a constraint** for quarry production remained stable with negative stances on the idea even diminishing over the 6 years (Figure 53);

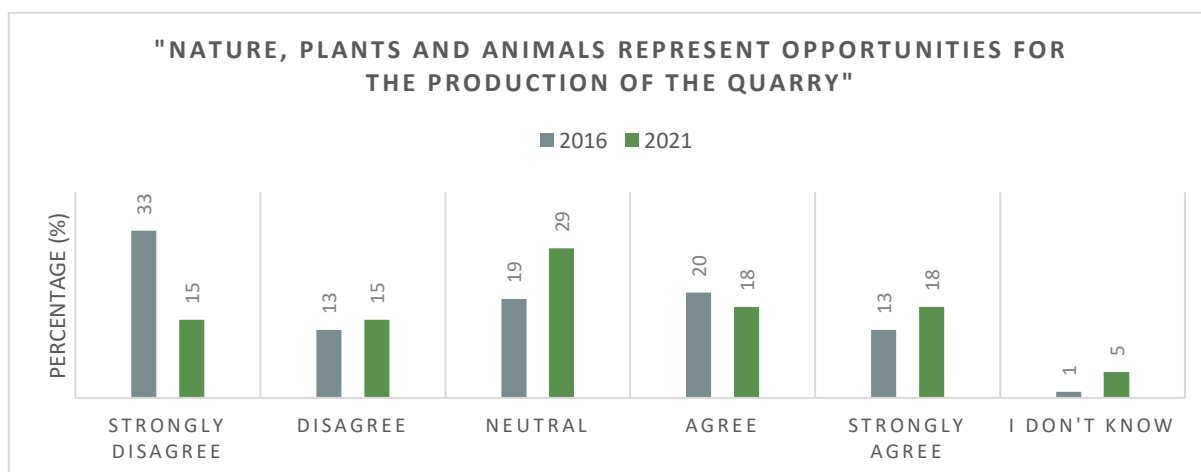


Figure 53. Percentages for the degrees of agreement with the statement “Nature, plants and animals represent opportunities for the production of the quarry”. Results from respondents of the LIFE in Quarries sites.

- The information on the project and to a broader extent biodiversity in quarries had increased over the lifetime of the project with a larger share of participants having been trained to it in 2021.

This increased knowledge and value attached to biodiversity was supported by the success of the ambitious awareness training campaign promoted by the LIFE in Quarries’ project.

The LIFE in Quarries case study demonstrated that increasing perception and commitment to biodiversity is not only a matter of information campaigns, but rather a question of increasing competencies on biodiversity at all position in the business sector through dedicated and continuous training actions.

c. Extra costs related to the management of biodiversity in quarries

Under sub-action D.6c, an analysis of extra costs related to the management of biodiversity was planned in order to allow for a quarry manager, interested in joining the LIFE in Quarries scheme, estimating resulting costs. While it was expected to define monetary costs, the variability in means of implementation, personnel and production costs, and resort to external expertise, from one quarry to the other lead to instead propose a report providing stages and estimated required means for the implementation of a complete dynamic management of biodiversity scheme.

The report provides a 3 stages schemes including an initial inventory phase and **definition of main stakes**, the **defining and implementation of an action plan** and the **monitoring of actions**. It provides also, for each action of temporary nature as well as for permanent ponds and linear scree (i.e. actions that can be implemented without an important external contribution – machines, expertise, material ...), an estimation of means required.

The definition for all 3 stages and for all actions expected **internal human resources**, **machines resources** and **financial resources (including expertise)** can serve as a tool for the estimation, by a quarry manager - based on internal costs - of overall expected costs that would result from biodiversity management within its own site.

VI.1.E Action E - Public awareness and dissemination of results

E.1 Notice boards

Foreseen start date: June 2016
Foreseen end date: June 2018

Actual start date: September 2016
Actual end date: March 2017

During the conceptualization, the GT-LIFE was actively involved to produce notice boards that adequately responded to practical usage and long-term installation onsite. Based on these discussions, 3 versions of notice boards were proposed at 3 different sizes (1.25 x 0.75m, 2.5 x 1.5m, A3-size) with appropriate pole structure.

- Version 1 A general notice board was proposed to be installed at the entrance of the site containing general information.



- Version 2 A didactic notice board was proposed to be installed inside the site with the objective of presenting the various actions of the project.



- Version 3 Small mobile boards (A3-size) were produced to indicate the presence of an action – to raise awareness and avoid unintentional perturbation of the created habitats. 50 new ones were reedited in 2019.



A total of 210 boards were produced in 3mm thick Alu Dibond with 187 adapted pole structures as summarized in the following table.

	v1	v2	v3	Adequate pole structure
Small (A3-size)	-	-	150	150
Medium (1.25 x 0.75m)	15	10		15
Large (2.5 x 1.25m)	20	15		22
Total	35	25	150	187

The distribution was organized in March 2017 to 24 quarries (for phase I and II.1). The installation onsite was carried out by quarry operators. Mobile boards were distributed gradually when actions were executed onsite.

Spare notice boards were installed in Phase II.2 quarries.

The soft posters foreseen for the associated beneficiaries were produced under the form of a set of 3 rollups. This choice, motivated by the enhanced mobility of the rollups that allowed increasing the visibility of the project, was agreed by EASME (Letter #3 – Ref. ARES(2017)2537987). 12 rollups were produced (1 set of 3 per beneficiary).

Also, 50 small notice boards were developed, produced, and distributed to quarries with eco-pasture action.

Finally, small notice boards were developed for quarries with bat galleries, electronic versions of these additional panel were made available to the relevant quarries.



A delay for the conception and installation of notice boards was caught up by delivering them to quarries of Phase I and II.1 at the same time.

E.2 Website creation

Foreseen start date: January 2016

Actual start date: February 2016

Foreseen end date: September 2020

Actual end date: December 2021

Launched online in April 2016, the website is operational in 3 languages (EN, FR, NL): www.lifeinquarries.eu.

As a central communication tool, it was designed to provide all information about the project, latest news, downloadable documents, and subscription to newsletters for stakeholders and public. The website is updated on a regular basis.

Multiple links to LIFE in Quarries website were created to increase its visibility, e.g., on associated beneficiaries/affiliates' websites but also on the LIFE page of the WR: <http://biodiversite.wallonie.be/fr/projets-life.html?IDC=3260>.

Individual restricted areas were created for the participating companies. It allowed, for each company, to have an access, with individual password, to the latest documents regarding the action of the LIFE in Quarries project on their site(s), e.g., biological inventory, action plan, yearly planning.

Facebook, LinkedIn, and Instagram pages were created for regular updates about the activities of the project:

- <http://facebook.com/lifeinquarries>
- <https://www.linkedin.com/in/life-in-quarries-69721a129>
- https://www.instagram.com/liq_belgium

A YouTube channel was also created with video presentations of the project (EN, FR, and NL, DE, and SP subtitles) and of its actions (EN, FR):

- <https://www.youtube.com/channel/UChsc6LFcocwNf0rVJrTSMVA>

The Website will be maintained alive in the After-LIFE (F.3).

Indicators

- Number of visitors for the website and visit rate: Google Analytics dashboard allows for 3-year history. As an example, from 26/10/2018 to 25/10/2021, we had 13.500+ visitors (i.e., 4.500+ visitors/year).
- Number of subscriptions to the newsletter: 616 (448 FR, 168 EN).
- Number of followers of the Facebook, LinkedIn, Instagram pages: respectively 750+, 1200+, 200+.
- Number of views of the project presentation videos in FR and EN: respectively 2.500+ and 1800+.

E.3 Networking with other projects

Foreseen start date: October 2015
Foreseen end date: September 2020

Actual start date: October 2015
Actual end date: December 2021

Regular contacts were made through meetings, events (InterLIFE, platform meetings, ...), informal discussions and exchanges of information. In Wallonia, the following projects were concerned:

- LIFE10 NAT/BE/000706: LIFE Ardenne liégeoise;
- LIFE10 NAT/BE/000709: LIFE Elia;
- LIFE11 NAT/BE/001059: LIFE Prairies Bocagères;
- LIFE11 NAT/BE/001060: LIFE Herbages;
- LIFE13 NAT/BE/001067: LIFE Pays Mosan;
- LIFE19 NAT/BE/000093: LIFE Connexions;
- LIFE14 IPE/BE/000002: LIFE BNIP;
- LIFE15 IPE/BE/000014: LIFE Belini.

Continuous involvement of the associated beneficiaries (Natagora, ULiège-GxABT, PNPE) in various conservation projects in Wallonia also helped to exchange information, experience, and networking.

The LIFE in Quarries project was presented at events organized by the LIFE program such as:

- InterLIFE Benelux 2016 (October 2016 – Poix-St-Hubert, BE);
- InterLIFE Benelux 2017 (October 2017 – Rossignol);
- InterLIFE Benelux 2018 (October 2018 – Soest, NL);
- InterLIFE France 2019 (September 2019 – Marseille, FR);
- LIFE Ecosystem Services platform meeting (May 2017 – Tallinn, EST);
- LIFE Connectivity platform meeting (March 2021 – online).

Exchanges with LIFE projects in other European states were initiated when participating at EU events, such as LIFE platform meetings, with:

- LIFE04 NAT/FR/000080: LIFE CHIROFRSUD;
- LIFE12 NAT/FR/000538: LIFE+ ENVOLL;
- LIFE13 NAT/LU/000782: LIFE Orchis;
- LIFE14 IPE/FI/000023: LIFE Freshabit;
- LIFE16 ENV/ES/000159: LIFE TECMINE.

Exchanges with other projects were also carried out, e.g., with HeidelbergCement Birdlife under a special workshop organized at SER Europe, the UEPG members with regular contacts, “LIFE Elia 2” in the frame of the development of grazing under high voltage lines in quarries, as a continuation of pre-established contacts with RESTORE actors, concerning invasive species management in the Walloon region (raccoon and cray fish), Cray fish conservation asbl Aspei

In total, we recorded 19 events and 13 LIFE projects contacted: 8 in BE and 5 others in EU.

Technical problem: in 2020-2021, the COVID crisis has had an important effect on all communication actions.

E.4 Redaction of the Layman's report

Foreseen start date: October 2015

Actual start date: July 2021

Foreseen end date: September 2020

Actual end date: December 2021

The Layman's report vulgarizes the main outcomes of the project in an English and French version.

As agreed with NEEMO, it was decided to print a reduced amount of paper versions (100 FR + 100 EN) to avoid unnecessary printing, in a digital communication world. Sufficient dissemination and visibility is being ensured through:

- Sending to the newsletters' diffusion list;
- Posting on the website and social media;
- A broader diffusion and availability on the University of Liège depository¹⁶;
- A use as dissemination tool in the After-LIFE (F.3) along with other communication supports.

Delay: the action has been postponed according to the prolongation of the project.

¹⁶ Available at : <http://hdl.handle.net/2268/268355> (EN) & <http://hdl.handle.net/2268/268354> (FR)

E.5 Good practices dissemination

Foreseen start date: October 2015
Foreseen end date: September 2020

Actual start date: December 2015
Actual end date: December 2021

In order to ensure the continuation and the durability of actions after the project, it was necessary to increase the autonomy of quarries in biodiversity. Action E.5 aimed at supporting this integration of biodiversity in daily management through training and dissemination of good practices.

Action E.5 consisted in 4 sub-actions aiming at (a) Training quarry staff from the base to the top; (b) Informing civil servants of the public administration associated to the life of quarries and specifically their biodiversity; (c) develop pedagogic support to provide tools for autonomous biodiversity management; (d) Transfer knowledge to EU partners.

a. Training modules for quarry personnel

The different training sessions were discussed internally and within the GT-LIFE to offer adequate modules and activities to the targeted quarry personnel. Specific modules were developed to answer specific needs and help in the implementation of concrete conservation actions. A debriefing after each session helped improve future modules.

The training session targeted three main levels of hierarchy:

- Quarry manager/biodiversity responsible

A four-day training session was organized in May (15-16) and June (12-13) 2017 for operation and environment managers. This module was organized in 2 sessions:

- Refresh on the theoretical aspects of biodiversity management in active quarries and aspects of the LIFE in Quarries project;
- On-site visits of 2 quarries: Hermalle and Calcaires de la Sambre, and practical exercises on temporary nature management plans.

The session was open to all quarry personnel involved in the project but also to a limited number of other stakeholders (members of FEDIEX non-participant to LIFE in Quarries ...). Inputs from external and administration allowed for a broader picture of biodiversity management in quarries.

A total of **36 persons** joined this session with a wide representation of quarries involved in the project. They provided beneficial feedbacks that led to the development of thematic sessions (see thematic trainings). These advantageously replaced a second round of Mr/Ms biodiversity training originally planned in the project.

A second session targeting both ***Amphibians and reptiles training*** and ***Basic monitoring*** (25 attendees, 2 sessions) was organized in May/June 2018. The training allowed to bring a special emphasis on two important biological groups in quarries and inform on the necessity and the how to implement an annual monitoring under action D.4.

Following the development of the AMBRES platform, a first round of on-site trainings of all site/environmental managers to Basic monitoring/AMBRES platform was also provided in 2019 in order to allow autonomy in the monitoring of actions (all quarries, under D.4).

In addition, **thematic trainings** allowed completing workers and Mr./Ms. Biodiversity's trainings through practical examples of species identifications and concrete conservation actions implementation. It went through specific ***Methods for ponds creations*** (9) and ***Birds platform building*** (9). While a potential for more training was identified, the Covid-19 crisis jeopardized implementation and the second round of ***AMBRES platform training*** (in 2020, 30 attendees, in association to action D.4) was re-oriented towards an online training associated to specific 4 video capsules as support (private session in Youtube with direct links from AMBRES platform. Sessions were organized by ULiège-GxABT with valued interventions from Natagora and PNPE experts.

An important number of hours spent on site by the LIFE in Quarries project team further allowed informal transfer of knowledge and awareness training.



Figure 54. Thematic training on Platform building (top left) and on Amphibians and Reptiles at Quenast (left) and Hermalle (bottom).

- Quarry workers

Individual modules to train quarry workers were organized in each quarry from April 2018 to September 2021, with delays on the planned schedule linked to gathering restrictions during the Covid-19 pandemic.

Short (approx. 2 hrs) sessions including the viewing of one of the selected video clip and a field visit led to on-site training of personnel tied to the project's quarries. Through visits of a sample of temporary and permanent nature actions implemented that allowed pointing out at target species, a total of **239 workers** from 25 quarries were introduced to their own site biodiversity and actions to favor it. Within sites, the splitting of personnel in small groups favored interactions and bringing answers to questions on the "for what?", "why?" and "how?".

The formula, reviewed from two-day sessions, allowed reaching for a larger number as the short duration did not jeopardize quarries' production activity.



Figure 55. Workers training at Trooz.

- Top manager (CEOs)

CEO's training was oriented towards top managers: **15 CEOs and site directors** of 12 companies were involved. A presentation of the main project stakes and objectives consisted in a 45 minutes exchange with an ULiège-GxABT expert. LIFE in Quarries video capsules were provided as additional resources to further explore the topic. The training ended with a c. 15 minutes online self-evaluation. It is expected that environmentally trained managers will play an important role in strengthening the ecological commitment of employees.

b. Information session for administration

Early discussions with the administration confirmed for an interest in holding a specific workshop intargetting the Walloon administration in charge of nature (DNF - Département Nature et Forêt and DEMNA – Département de l'Etude du Milieu Naturel et Agricole).

While a specific workshop, as intended in the project description, could not be organized it was advantageously replaced by:

- Visits of all sites involved in the long-term commitment under action D.5 with civil servants from the DNF. A total of **37 DNF agents** visited sites under their jurisdiction along with the quarry manager/environmental responsible and the project's team. Visits aimed at understanding the concept of dynamic nature management applied to quarries, see actions implemented on sites and exchange on the long-term commitment process. It helped provide a common understanding of derogations to the Nature conservation Law, facilitating exchanges with the administration in sub-action D.5b;
- A presentation of the AMBREs platform to the DEMNA was given to explain the process of the project and its practical implementation and monitoring;
- 3 distinct presentations (2016, 2020 and 2021) at the Pole Ruralité - Comité Supérieur Wallon de la Conservation de la nature (CSWCN) in charge of providing counsel to the public administration on derogation demands;
- Presentations of the LIFE in Quarries project to 3 distinct local administrations hosting a project's site;
- A presentation of the project to the "Contrats de Rivières".

c. Supports for good practices dissemination

Specific supports have been produced to illustrate biodiversity actions, facilitate monitoring of habitats and species by quarries actors, and provide basic and detailed information for implementation of concrete conservation actions. They increased the autonomy of quarries and served well beyond the project.

- **5 Video capsules**¹⁷ on temporary/permanent habitats' creation and maintenance interactively illustrate, in 5 minutes, techniques for temporary habitats' creation and dynamic management as well as benefiting species. They are associated to an 8 minutes **large-scale dissemination video** presenting the project and the concept of temporary nature management. The quality of the videos (realized following a public tender awarded to the company WILD CLOUD PRODUCTIONS) have often been praised within and outside of the sector. A total of 500 DVDs have been produced for the dissemination to participating quarries and active stakeholders at regional and EU level and the videos were deposited online (Youtube) in English, French and subtitled in Spanish, Dutch and German;
- **11 Factsheets on species and temporary habitat's creation and maintenance**¹⁸ summarize key messages for management of the different taxonomic groups (Amphibians, Reptiles, Birds, Dragonflies, Flora) and /or habitats (Pioneer ponds, Pioneer grasslands, Sand cliffs, Shelters and screes, Permanent ponds and Birds platforms). These factsheets are easy to use by managers and workers on the field and deliver easy and synthetic information focused on techniques;

¹⁷ Available at <https://www.youtube.com/channel/UCHsc6LFcocwNf0rVJrTSMVA>

¹⁸ Available at <https://orbi.uliege.be/handle/2268/242451>

- **An online picture database** of target species was made available through the AMBREs interactive platform. Pictures allow site managers to further develop their own competencies on species identification;
- **A Methodological guide on temporary nature management**¹⁹ was produced. This guide synthesizes the lessons learned from the project into a practical guide relating ways to implement temporary nature actions. The document first introduces the temporary nature management in quarries and then compile outcomes of the project in illustrated chapters associated to temporary nature (C.2) actions. Doing so, it further develops the content provided in the Factsheets cited here above. It will serve as a reference for quarries and allow ensuring autonomy of quarries in their future implementation of actions. It aims at providing synthetic and richly illustrated practical/technical guidance that were lacking from the literature on the subject.

d. Training of EU partners

The training of EU partners was associated to sub-action C.4b with information and field visits allowing to train quarry operators of 7 quarries as well as representatives of National aggregates federations

While the opening of training sessions to EU quarry operators could not be realized, the on-site sharing during the C.4b-EU site visits allowed reaching a similar audience and applying theoretical temporary nature management to their very own specific contexts. This sub-action was completed with multiple exchanges at the EU level as part of action E.6, E.7 and E.8.

Technical problems / delays:

Training sessions:

Slight delays were met for the implementation of the modules to top-managers and quarry workers without major impact on the project implementation. Some of the Quarry workers training sessions (Specifically Phase II sites) were delayed as a result of Covid-19.

Communication supports:

- **Factsheets:** Slightly beyond schedule in the elaboration of the factsheets. The production allowed a publication quasi-simultaneous to the release of the video capsules to gather a consistent and complete package of deliverables for the quarry operators;
- **Videos:** spring and summer 2017 were the adequate periods to film targeted species and habitats. Indeed filmmakers filmed in about 10 participating quarries from May to September in order to catch all images. The post-production period extended until the beginning of 2018 and videos were then progressively released online;
- **Methodological guide:** The edition and publication of the methodological guide was delayed as other actions took priority. Thoughts on the best format of the guide further delayed the edition as a proposition to develop a MOOC had to be abandoned as it revealed too expensive, time consuming and not optimal. Instead we revert to the idea of an illustrated guide allowing to encompass a wide diversity of methods to implement temporary nature actions with links to video capsules guide. Rather than developing another online training platform for new operators joining the project, we expect the development of new Mr/Ms biodiversity training sessions in the After-LIFE (see action F.3) will allow for in person exchanges with project sites providing ground for observation of concrete implementation. This shall answer outcomes of D.6 action that dedicated and continuous training actions were needed to raise knowledge and awareness on biodiversity.

¹⁹ Available at <http://hdl.handle.net/2268/268136> (EN) & <http://hdl.handle.net/2268/268137> (FR)

E.6 Increased public awareness

Foreseen start date: October 2015
Foreseen end date: September 2020

Actual start date: October 2015
Actual end date: December 2021

a. **General awareness campaign**

The initial step was to design an attractive graphic identity for the LIFE in Quarries project giving a clear identification and visibility of all supports produced during the LIFE in Quarries. A general **folder** was produced to support all communication activities of the project. A 1st edition was produced in April 2016 at 6.000 copies in 4 languages (FR/EN/DE/NL). An updated version, with additional logos, was printed in July 2018 at 6.000 copies.

10 **newsletters** have been published in French and English to inform on the progress of the project and posted on the website, as <http://www.lifeinquarries.eu/documents> summarized in Table 13. The distribution list, initially elaborated in action A.5, was regularly updated with new contacts made during the project and via online subscription available on the website. The number of subscriptions to the newsletter amounts to 616 (448 FR, 168 EN).

Table 13. Summary of edited LIFE in Quarries newsletters.

	Publication date
<i>Newsletter #1</i>	05/07/2016
<i>Newsletter #2</i>	21/10/2016
<i>Newsletter #3</i>	28/06/2017
<i>Newsletter #4</i>	21/12/2017
<i>Newsletter #5</i>	31/07/2018
<i>Newsletter #6</i>	31/01/2019
<i>Newsletter #7</i>	26/08/2019
<i>Newsletter #8</i>	10/12/2019
<i>Newsletter #9</i>	31/08/2020
<i>Newsletter #10</i>	21/01/2022

Newsletter #10 has been edited in December 2021, then published and posted on the website in January 2022.

The **communication campaign** objective was to raise awareness of the different stakeholders through a series of media and events. In total, we recorded 151 items of which:

- 22 articles in specialized magazines forecast: 15
- 18 articles in the journals of professional federations forecast: 10
- 18 articles in national or local press forecast: 10
- 6 TV reportages forecast: 1
- 5 radio reportages forecast: 3
- 62 events with project presentation (of which 22 in BE, 40 at EU level) forecast: 8

Key actions included the TV reportage “Le Jardin Extraordinaire” on national channel RTBF (11/11/18 – 350.000 viewers).

b. **Public in quarries**

Quarry visits were regularly guided by the LIFE in Quarries team to disseminate the key message “biodiversity is compatible with economic activity in active quarries”. In total, we recorded **46 open quarry days**.

Technical problem: in 2020-2021, the COVID crisis has had an important effect on all communication actions, and especially on the organization of open quarry days.

The **observation platforms** started with a multicriteria analysis (accessibility to the public, biogeographical situation, sociocultural situation, landscape interest led by a Master Thesis of Camille Bontemps: to select best sites for implementation.

Delays in the preparation phase were faced related to COVID-19. The master thesis at the origin of the action (multicriteria analysis) took longer than expected. The onsite meetings (key for this action) needed more time to take place. Also, the permitting process took longer than expected. Finally, one permit has been challenged.

As a result, the situation is as follows:

1. One platform has been completed at Carrières de la Warche

The foundation of the platform has been realized with stones from the quarry. A permit was not needed which allowed to complete it in due time.



2. One platform will be completed at Carrière de la Boverie (Jemelle)

The permit is due by end of Q1 2022 upon which the quarry operator is committed to carry out the works with own resources. Expected timeframe for completion is end of Q2 2022.



3. One platform will be completed at Carrière de Lustin

The permit has been received but subsequently challenged. Upon solving the situation, the quarry operator is committed to carry out the works with own resources. Timeframe is uncertain as dependant on legal procedures.



Didactic information panels have been developed for the 3 platforms (Figure 56).

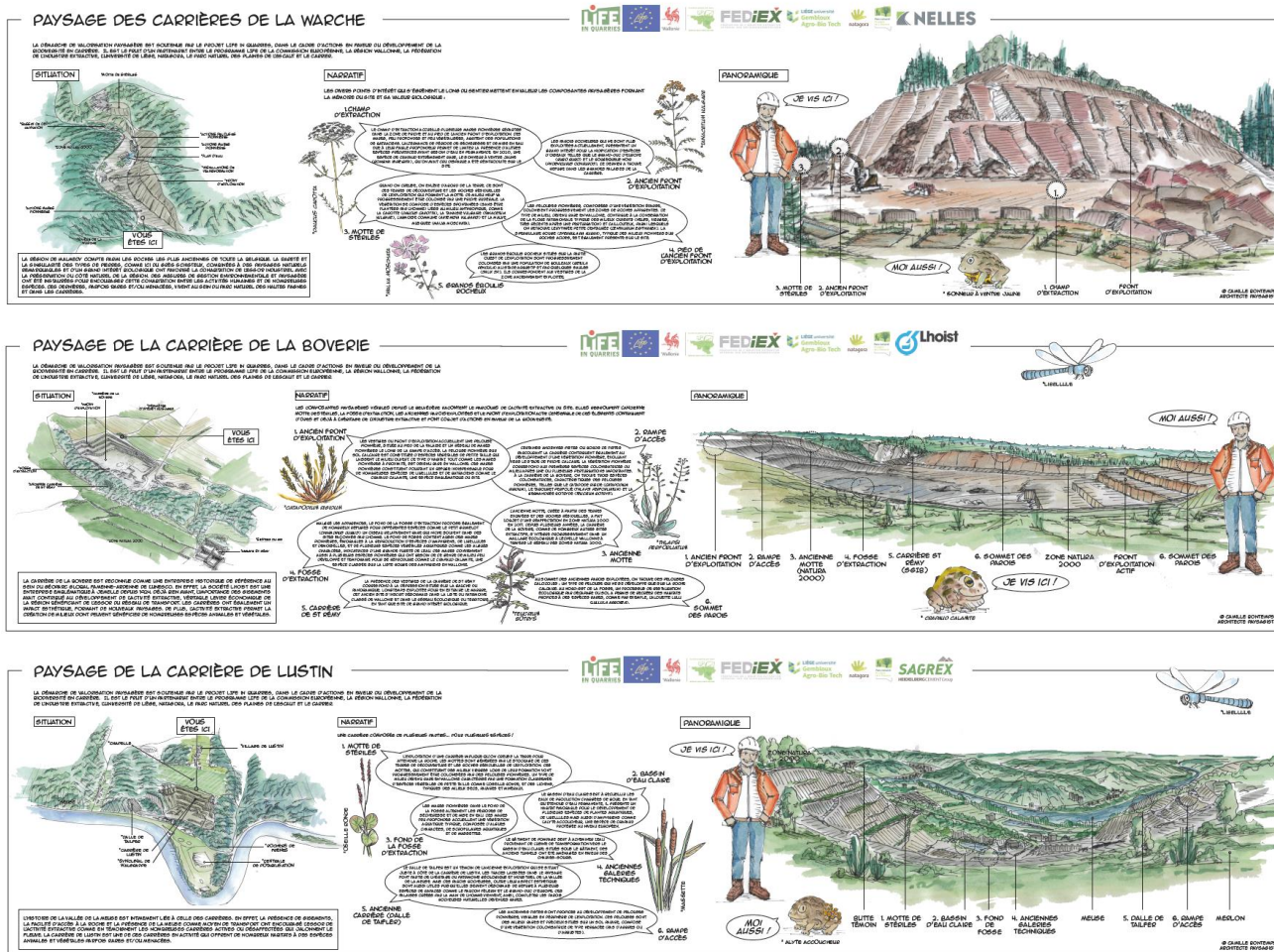


Figure 56. Illustrative panels developed for the 3 Observation platforms.

For the 2 remaining platform full expenses will be covered for by quarries while information panels have been included in project expenditure as discussed with technical monitor.

In association to planned actions, the LIFE in Quarries hosted a total of 20 intern students helping in their training and widely benefitting from their studies. These interns' awareness has been highly raised throughout contacts with the team and on-site personnel and actions.

E.7 Dissemination at European level

Foreseen start date: October 2015
Foreseen end date: September 2020

Actual start date: October 2015
Actual end date: December 2021

During the preparation of the initial workshop (action A.1), a set of experts, from extractive industries, national or European associations, European commission, and NGOs, intervene about their experience in temporary or permanent nature management on quarry sites.

At this initial workshop, key-experts were invited to join the LIFE in Quarries European Working Group as contact point to provide feedback on the progress of the project and to get feedback from the WG members on practices and innovative approaches developed in other EU countries.

The 1st EU working group meeting was organized in Brussels on 12/12/2017 with attendance of 24 key-experts. The meeting was divided in 2 parts (minutes/PPT posted on website):

- AM session to provide feedback on progress of the project implementation, and first results;
- PM session dedicated to the legal aspects of the dynamic biodiversity management concept.

The 2nd EU working group meeting was organized in Jemelle on 13/05/2019 with attendance of 24 key-experts. The meeting was divided in 2 parts:

- AM session to provide feedback on progress of the project, and ecosystem services in active quarries;
- PM session dedicated to a site visit.

The 3rd EU working group meeting was organized online on 08/12/2021 with attendance of 24 key-experts. The objective was to have a demonstration of AMBREs. The agenda covered the following: background behind such platform (experience from the field, database management, dynamic functionalities: especially useful for temporary nature management), demonstration with scenario, Q&A. Some if not most participants attended the project final conference shortly before (so there was no need to provide feedback on the project progress).

In addition, regular information of the project and its results were provided to different EU stakeholders through various events. In total, we recorded 46 actions often answering E.6a objectives too including:

- EU GreenWeek 2019: project presentation, and site visit (Moha – 14/05/19);
- Mainstream Biodiversity the way to go!: Presentation of the Project with emphasis on its actors at an event organized by the EESC (European Economic and Social Committee January 2020)
- EU GreenWeek 2020: video presentation at the UEPG booth (October 2020);
- EBNS 2021: part of the panel of speakers at BirdLife side event (December 2021 - EU Business and Nature Summit was organized by the EU Business & Biodiversity platform);
- EUROGYPSUM: Presentation of the project to the Eurogypsum quarry WG (November 2021);
- Constant interactions with the UEPG's specific events and work on the development of two proposals (BioQuarryPark – rejected & BioQuarryWild – in proposal stage) in the frame of the Horizon 2020 programme;

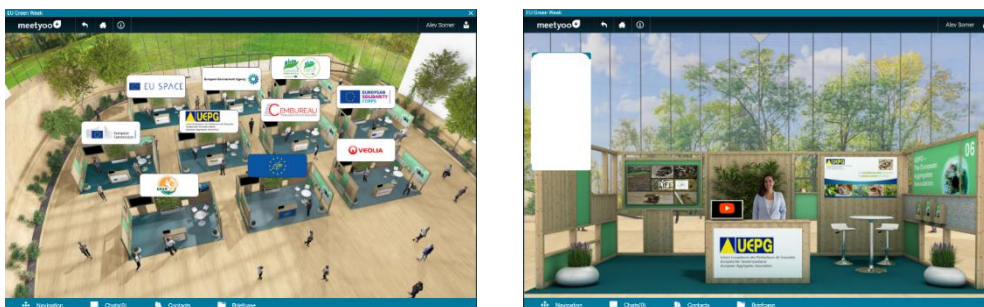


Figure 57. UEPG Virtual stand at the 2020 EU Green week with a focus on the LIFE in Quarries.

Additional networking at EU level was carried out by participation to various scientific conferences such as e.g.

- Society for Ecological Restoration EU 2016 (Freising, DE);
- Société Herpétologique de France (2016 & 2021);
- Quarries Alive 2018 (Evora, PT);
- Society for Ecological Restoration 2019 (Cape Town, South Africa).

The project has also been playing an important role and influencing the recent sector's Code of Conduct aiming at conducting the management of protected species at the EU level. The document, at the initiative of HeidelbergCement with BirdLife Europe, Cembureau, UEPG and Eurogypsum, cites the LIFE in Quarries as a practical implementation of the Code's philosophy²⁰.

An acknowledgement of the LIFE in Quarries contribution in the development and implementation of the Temporary nature concept also led to the project being referenced in the Commission '*Guidance document on the strict protection of animal species of Community interest under the Habitats Directive*' (C(2021) 7301 final - 3.3.5. Temporary nature: dealing with the colonisation of sites under development by species listed in Annex IV)²¹.

Delays: 1st EU working group meeting was postponed because the comparative study and proposed legislative improvements appeared necessary to feed the discussion and debate at EU level. This delay was accepted by EASME (Letter #3 – Ref. ARES(2017)2537987).

Initially, it was planned to organize 1 EU working group meeting per year. It was finally decided to organize it once every 2 years as most of the EU working group members were in contact with the project through exchanges (and other events). As shown by the number and quality of events organized or attended, the project has been successfully disseminated at the EU level.

²⁰ Available at https://www.birdlife.org/wp-content/uploads/2021/10/Code-of-conduct_With-signatures_Digital-low-res.pdf

²¹ Available at https://ec.europa.eu/environment/nature/conservation/species/guidance/index_en.htm

E.8 International workshop

Foreseen start date: April 2020

Actual start date: July 2021

Foreseen end date: September 2020

Actual end date: October 2021

The active participation at the Quarries Alive 2018 conference in Portugal was very much appreciated amongst the audience and organizers. It was a successful initiative, and the organizers proposed a continuity at EU level.

The LIFE IN QUARRIES team seized the opportunity to organize the Quarries Alive 2020 conference in combination with the LIFE IN QUARRIES final conference. Unfortunately, the event was canceled due to COVID.

Despite the difficult context, the LIFE IN QUARRIES team succeeded to organize a physical international workshop in Brussels on 27/10/2021, in hybrid mode – the conference was also available online.

The event took place at the Federation of Belgian Enterprises premises for its unique location, and professional services, especially hybrid events, through its exclusive partnership with Webinar Solutions. Also, as a member federation, FEDIEX was able to benefit from significant discounts (40% on the room and 20% on the streaming).

The event was attended by 170 participants (60 in Brussels and 110 online).

Program and presentations are available on the project website.

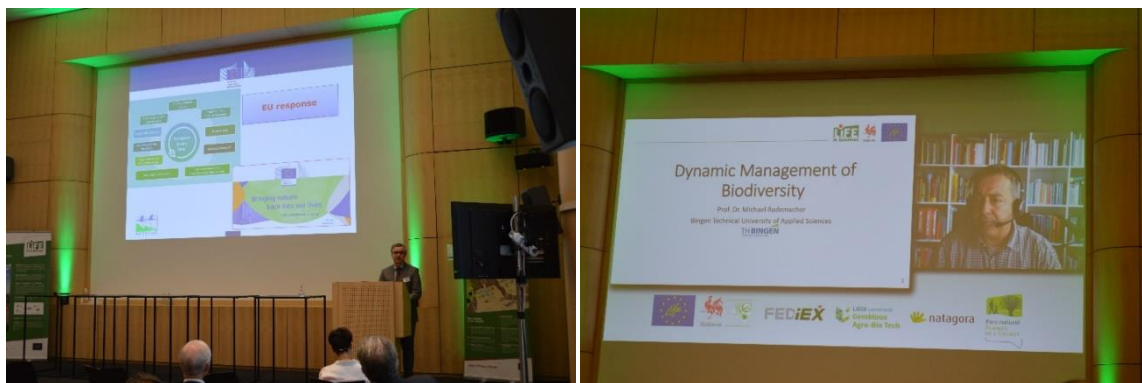


Figure 58. External interventions are the Final International Workshop: Mr. Przemyslaw Oginski and Pr. Michaël Rademacher.

On 28/10/2021, 2 site visits were organized (50 participants) followed by a closing lunch onsite.

Delay: the action was postponed according to the prolongation of the project.

The abstract book was replaced by a compilation of the presentations available on the project's website.

VI.1.F Action F - Project management and monitoring of project progress

F.1 Overall project management

Foreseen start date: October 2015

Actual start date: October 2015

Foreseen end date: September 2020

Actual end date: December 2021

The management and administrative structure implemented for the project has been described in section V.1.

Alexandre Sneessens, then Victor de Neve (from Sep 2020) ensured the project coordination at FEDIEX. Maxime Séleck, the project scientific coordinator at ULiège-GxABT, was hired by FEDIEX in Q1 2022 (so not on the project budget) for the final report. Nicolas Hoffait, then Céline Druetz, who also reinforced the project communication, reinforced the project administration at FEDIEX.

FEDIEX statutes involve a recurring turnover in the presidency of the association every 3 years. Over the course of the project, the following presidents have been the person legally authorized to represent the organization: Jean Marbehant, Fabrice Delaunoy, Stephan Milis (from 23/04/21). The latter has signed amendment request #5. Michel Calozet, Managing Director, remained the contact person for the project.

ULiège-GxABT staff also evolved over the project with Maxime Séleck as scientific coordinator first working with Laura Maebe on ES and consciousness (A.6-D.6). Ms Maebe was replaced by Kathleen Mercken who overtook ES responsibilities and provided support to implementation of actions. Sylvain Boisson who worked on developing the AMBREs platform upon request to EASME completed the team in 2019 (D.4). Upon leave of Ms Mercken in the end of 2020, Lilly Gillet joined the project and supported the finalization of the AMBREs platform as well as working on ES reports (D.3). Vladimir Joassin took the responsibility of interviews for the report on the sector's consciousness under action D.6. He worked between the end of 2021 and mid-2022.

Meetings

The coordinating beneficiary organized regular meetings of the committees / working group to discuss project progress as presented in Table 14 alongside with the NEEMO meetings.

Table 14. List of committee/working group and NEEMO meetings and reporting

Date	Meeting	Reporting
20/10/15	GT-LIFE	PV meeting (n°2015-183)
13/11/15	GT-LIFE	PV meeting (n°2015-188)
18/12/15	Scientific Committee	PV meeting
11/01/16 AM	NEEMO	PV meeting (n°2016-008) and EASME letter #1
11/01/16 PM	NEEMO/Steering Committee/GT-LIFE	PV meeting (n°2016-007)
23/03/16	GT-LIFE	PV meeting (n°2016-069)
19/04/16	Monitoring Committee	PV meeting (n°2016-090)
21/06/16	Scientific/Steering Committee	PV meeting
26/09/16	Monitoring Committee	PV meeting (n°2016-161)
20/10/16	Steering Committee	PV meeting (n°2016-161)
28/10/16	GT-LIFE	PV meeting (n°2016-186)
01/12/16	Steering Committee	PV meeting (n°2016-212)
07/03/17	NEEMO	EASME letter #3
28/03/17	GT-LIFE	PV meeting (n°2017-061)
24/04/17	Monitoring Committee	PV meeting (n°2017-072)
29/06/17	Steering Committee	PV meeting (n°2017-117)
09/10/17	Monitoring Committee	PV meeting (n°2017-177)
07/11/17	GT-LIFE	PV meeting
07/03/18	GT-LIFE	PV meeting (n°2018-050)
23/05/18	Monitoring Committee	PV meeting (n°2018-079)

27/06/18	NEEMO	EASME letter #5
05/09/18	Steering Committee	PV meeting (n°2018-178)
26/09/18, 16/10/18	GT-LIFE	PV meeting
04/10/18	Monitoring Committee	PV meeting (n°2018-189)
20/03/19	GT-LIFE	PV meeting (n°2019-093)
02/04/19	Steering Committee	PV meeting (n°2019-098)
23/05/19	Monitoring Committee	PV meeting (n°2019-141)
29/05/19	Steering Committee	PV meeting (n°2019-143)
26/06/19	NEEMO	EASME letter #7
18/10/19	Monitoring Committee	PV meeting (n°2019-218)
13/11/19	GT-LIFE	PV meeting (n°2019-235)
28/05/20	NEEMO	EASME letter #8
07/09/20	Steering Committee	PV meeting
16/09/20	GT-LIFE (through FEDIEX Environment Committee)	PV meeting (n°2020-238)
13/10/20	Monitoring Committee	PV meeting (n°2020-205)
16/11/20	Steering Committee	PV meeting
02/12/20	GT-LIFE (through FEDIEX Environment Committee)	PV meeting (n°2021-054)
19/01/21	Steering Committee	PV meeting
17/03/21	GT-LIFE (through FEDIEX Environment Committee)	PV meeting (n°2021-148)
18/05/21	NEEMO	EASME letter #9
09/06/21	GT-LIFE (through FEDIEX Environment Committee)	PV meeting (n°2021-262)
03/09/21	Monitoring Committee	PV meeting (n°2021-203)
15/09/21	GT-LIFE (through FEDIEX Environment Committee)	PV meeting (n°2021-262)
15/11/21	Steering Committee	PV meeting
01/12/21	GT-LIFE (through FEDIEX Environment Committee)	PV meeting

Project reporting: Annual reporting to the European commission and biannual reporting to the Walloon region was as follows:

Table 15. List of project's official reports.

Report	Date
Intermediate report #1	19/04/2016
Progress report #1	30/09/2016
Intermediate report #2	24/04/2017
Midterm report	15/10/2017
Intermediate report #3	23/05/2018
Progress report #2	30/09/2018
Intermediate report #4	23/05/2019
Progress report #3	30/09/2019
Intermediate report #5	15/04/2020
Progress report #4	30/09/2020
Intermediate report #6	03/09/2021

F.2 Financial audit

Foreseen start date: July 2020

Actual start date: January 2022

Foreseen end date: September 2020

Actual end date: February 2022

In Accordance with Art. II.24.2, the approved auditor who has been selected to establish the certificate for the payment of the balance is:

CdP De Wulf & Cie. SCPRL (n° BE00366)

Contact: M. Vincent De Wulf, registered Auditor, Partner

Address: Rue de l'Hospice Communal 6, B-1170 Bruxelles

Tel: 02/663.11.20

Mail: v.dewulf@cdp-partners.be

Delay: the action has been postponed according to the prolongation of the project.

F.3 After-LIFE plan

Foreseen start date: April 2020

Actual start date: July 2021

Foreseen end date: September 2020

Actual end date: December 2021

The After-LIFE plan presents an overview of realizations, a five-year conservation plan, a continued implementation of communication actions and summarizes the means for funding.

Specifically for the implementation of the project's framework to new sites, the possibility for new quarries to apply the process will be facilitated by a Management plan canvas and associated derogation canvases.

Annual and 5-year monitoring (see After-LIFE, F.3) will allow following the continuous implementation. The development of a Terms of Reference for call to experts defines the expected studies and outcomes.

Details are provided in the comment boxes of related KPIs under action F.4.

Delay: the action has been postponed according to the prolongation of the project.

F.4 Indicators

Foreseen start date: October 2015

Actual start date: October 2015

Foreseen end date: September 2020

Actual end date: February 2022

LIFE Programme indicators were initially filled in 2016 and completed upon completion of the project, in February 2022. The list was consecutively validated by NEEMO and exported from the portal.

Ecosystem services relevant indicators (7.1 & 7.2) were filled as to report on ecosystem services in an adapted version of action D.3. ES reported were the ones for which the project presented an important impact in consideration to impacts linked to the life cycle of quarries that were also reported in report D.3.

The online system not accommodating Numbers for 7.4 indicators some best estimates had to be realized for surfaces of both Pioneer and Permanent ponds (C.2a and C.3a) while figures for Vertical faces (C.2c), Shelters (C.2e), Tern/Common gull Platforms (C.3c) and Bat galleries (C.3d) had to be dismissed. Realized numbers for these actions are however to be found under action D.5 while expected number within a 5-year time frame are presented in the annex of the After-LIFE plan (F.3). Total ponds surfaces were best guessed and summarize as ha using a rule define in comments of the KPIs.

Delay: the action has been postponed according to the prolongation of the project.

VI.2. Main deviations, problems and corrective actions implemented

Although planned for a 5-year duration, the LIFE in Quarries project ended in December 2021 after 6 years and 3 months (see section V.3 - Amendments to the Grant Agreement).

Some technical actions and deliverables have been slowed down due to the number of stakeholders involved. This is particularly true for:

- C.2 - Translocations of amphibians suffered delays for *Triturus cristatus* and *Bombina variegata* as a result of pre-required meeting of conditions such as suitable habitats creation, identification of source populations, authorization from regional authority... Both sub-actions will need a continued implementation in 2022 as part of the After-LIFE plan (F.3) increasing the long term chances of success;
- C.3/C.4 - Installation of fences for grazed grasslands. The choice was made to call for a single and global tender for the 9 quarries concerned by this action. The procedure revealed to be quite complex to finalize all perimeters with the necessary requirements and launching the tender call;
- D.4 – An iterative process in the development of a basic monitoring scheme and the development of the monitoring platform (AMBREs) has extended the initial deadline of the action D.4. This was justified by trainings rapidly shown the need of a user-friendly and cartographic tool as a key element for better sustainability on the long-term;
- A.4 and D.5 - Both actions progressed slower than initially foreseen. Indeed, these structural actions dealing with long-term engagement, required more time to adequately address the stakes at play and find a proper solution complying with all stakeholder's enquiries: legal consultant, partners and the regional authority. Additional time allowed for a coherent scheme to be implemented in affiliated sites;
- E.5c - Good practices dissemination. Some delays appeared for the production of some of the communication supports as it resulted more interesting to integrate outputs of other actions for documents to be self supporting. It was largely compensated by presence of the LIFE in Quarries' team expertise on site accompanying the staff in implementation;
- E. actions (section VI.1.E) - The COVID pandemic has impacted the project implementation during the final period restrictions have principally affected the following actions:
 - C.4b - dissemination at EU level: travel restrictions across EU complicate the organisation of international visits. Unclear visibility for the future is also affecting the discussion with international companies or federations. Serious contacts were put on hold and are currently being resumed with the following organizations/partnerships
 - Communication actions – E.5, E.6, E.7, E.8: a whole diversity of communication actions involving physical presence of regional/international audience had to be cancelled. Virtual events were organized for crucial actions, e.g. two virtual training sessions were organized in E.5 for implementation of D.4, a 2020 or 2021 Open quarry days sessions (E.6) could not be launched an EU Working group (E.7), and an expected Quarries Alive II scientific conference (under E.7) that could not be maintained. The Final workshop (E.8) had to be organized in hybrid mode because of the pandemic as well.
- F.1 - The project coordinator changed from September 7th, 2020. Mr Victor De Neve replaced Mr Alexandre Sneessens, the transfer period having somehow affected the finalization stage of the project.

The amendments approvals allowed providing more time for the finalization of these specific actions.

Associated to these delays, the concrete achievements of the project may have seen their initial objectives unachieved due to various constraints though not significantly affecting the overall objective of the project. However, these gaps in the concrete conservation actions have been largely compensated by the development of other actions well beyond the initial objectives and allow compensating for:

- C.2d - The loss of the sub-action C.2d-Dynamic screes and equivalent in C.4 (combined objective of 5.00 ha) as a result of a much reported security concern by an extensive surface of pioneer grasslands (C.2b) - playing similar biological roles and hosting the same targeted species - implemented and

committed (**combined C.2b and C.4a equivalent objective** : 12.00 ha – **realized** : 30.75 ha; **committed** : 25.1 ha; **proposed revised objective** : 12.00 + 5.00 ha = 17.00 ha, see action C.2d);

- C.2/C.3/C.4 - The under-realization for Last-blasting (C.3g) - an innovative idea to create scree with blasting appeared to be difficult to implement in quarries under activity due to security risks. However, the method would be very interesting to create scree at a final stage, when activity ceases in the quarry and hence be part of the rehabilitation - and for linear scree (C.3h) were advantageously compensated by the presence of multiple shelters (C.2d) situated in permanent nature areas but also by the rocky substrate included in part of the permanent grazed (C.3f) and/or mowed (C.3e) grasslands. This is particularly true for sites with known presence of Smooth snake (*Coronella austriaca*) and Wall lizard (*Podarcis muralis*), originally targeted by the action that are also occurring in these habitats and their edges. Sites with both targeted species and large areas of grazed/mowed grasslands with rocky substrates include Jemelle, Hermalle, Leffe, Trooz, Moha, Les Petons and Marche les Dames (only occurrence of Wall lizard known to date);
- E.6b - Realizations of 2 from the 3 targeted observation platforms encountered delays and challenges in the permitting process that prevented their completion in due time. The commitment of both quarries in question to carry out the works with own resources upon delivery or confirmation of the permit will allow the overall objective to be reached;
- D.5 - As of 15/06/2020 the quarry of Mettet (Sibelco) ceased operations permanently and therefore left the scope of the project leading to the absence of a committed management plan. Nevertheless, the LIFE in Quarries team has been in contact with both the local administration and the new entrepreneur taking over the site and all collected information has been transferred to an environmental counsel in agreement with SIBELCO.
- D.5 - Though not affecting the initial objective of 18 charters signed in the project, the last request for derogation being submitted for the Lustin quarry should allow its charter to be signed in the first semester of 2022 to reach a total 26 charters and committing Lustin quarry as well over the long-term.

VI.3. Evaluation of Project Implementation

VI.3.1. Methodology applied

The LIFE in Quarries project has allowed to develop a methodology of implementation of action first tested on 14 phase I sites (and within these prior implementation were realized on 2 “pilot” sites) and then reproduced to 13 additional sites in Phase II.1 and II.2. The experience from the first 14 sites allowed gaining experience and adjusting the methodology for a smoother implementation. The methodology first consisted:

- (i) In inventories under **VI.1.A.3a-Biological inventories / A.6-Evaluation of the ES significance of quarries in the landscape**; then
- (ii) Of concrete conservation action definition and implementation under **VI.1.A.3b-Management plans / C.2-Implementation of temporary nature management plan / C.3-Implementation of permanent nature management plan**; and,
- (iii) Of internalized monitoring associated to long-term commitments: **D.4-Basic monitoring / D.5b - Redaction and signature of charters**.

While the first two stages were first run in Phase I sites, the time necessary to the finalization of actions on sites, for the development of the Basic monitoring and in the definition of the content of long-term management plans, associated derogations and charters led to the work being done for sites from both phases in parallel. This did not jeopardize the process and facilitated a common approach in this final phase.

The details of the LIFE in Quarries framework are presented in the Layman’s report, in the introduction of the methodological document developed under action E.5c and in the report of action D.6c. The latest associates some required means allowing to define the cost-efficiency of actions at the specific quarry level by applying the own quarry’s costs.

Specifically, for temporary and permanent nature conservation actions, the method of creation has been constantly adjusted for each action to develop the most effective best practices for the quarry operators.

The initial assessment of the state of the art on temporary nature management (action A.1) allowed defining the methodologies of all C.2 actions to be tested and further investigated. The assessment was based on a scientific literature review and completed by direct contacts with stakeholders involved in the management of temporary nature. It supported, at the final stage of the project, the redaction of the methodological document (under action E.5c).

The implementation of permanent nature actions benefited from the project's team previous knowledge and, from the presence of personnel and machines on sites that allowed confirming a much better cost-efficiency in comparison to conservation works that would take place in a natural environment. Availability of personnel allowed the objectives to be surpassed for most of the C. actions.

VI.3.2. Results achieved

Table 16 summarizes the results achieved throughout the project and provide a summarized evaluation of the achievements against the objectives foreseen in the proposal. The original targets of the project the actions refer are defined under section **IV.1.1**. Detailed information for each action and sub-action is to be found in section **VI.1 Technical progress, per Action**.

Table 16. Actions implemented in the frame of the project with the objectives foreseen in the proposal, Targets to which they refer to (see section IV.1.1) and Status of achievement ("v": Achieved; "-": not completed; "±": Explanation provided).

Action	Foreseen in the proposal	Targets	Achieved	Evaluation
A.1	A literature review document and a workshop	T1, T5	v	Both literature review and the initial workshop helped further define actions to test under C.1
A.2	A list of indicators	T1, T2	v	The initial indicators needed to be revised throughout the project without jeopardizing implementation.
A.3	Inventories and action plans for 24 quarries	T1, T2	v: 27	Inventories guided the proposed actions plans that were all validated for implementation in C.2 to C.4a
A.4a	Proposing legal solutions to adapt legislative lock-ins	T3	v	The study allowed defining a derogation scheme allowing fitting within the Habitats Directive without a need to adapt the legislation resulting in it being largely deployed under D.5.
A.4b	Analysis of quarry exploitation plans, legal obligations and opportunities	T3	v: 24+3 individual analysis	While a global synthesis did not appear relevant, the evaluation of individual permits allowed determining no significant conflict/issue with temporary nature management.
A.5	Creating a quarry network integrating target audiences	T4, T5	v	The broad network allowed for the dissemination of project outcomes.
A.6	An evaluation of the importance of quarries for ES and GI	T2	v	The initial evaluation of ES allowed providing guidances for the implementations of C.3 actions
C.1	Testing temporary nature creation	T1	v	Tests set in different quarries allowed limiting unsuccessful actions in C.2 implementation
C.2	implementing adapted methods at large scale	T1	v	To the exception of sub-action C.2d, the implementation and commitments for temporary nature went well beyond the original objectives of the project demonstrating feasibility.
C.2a	120 Temporary ponds	T1	v: 403	
C.2b	12 ha of pioneer grasslands	T1	v: 30.75	
C.2c	10 Vertical faces	T1	v: 14 + 18	14 vertical faces targeting Sand martins were completed by 18 sand banks targeting solitary bees
C.2d	5 ha of pioneer screens	T1	- → v	Security concern and evolution of the project finally lead to replace this action by pioneer grasslands
C.2e	96 Shelters	T1	v: 403	
C.2f	8 Patrimonial plants developed	T1	v: 10	

Action	Foreseen in the proposal	Targets	Achieved	Evaluation
C.2g	4 Translocated populations of <i>Bufo calamita</i>	T1	v: 5	
C.2h	4 Translocated populations of <i>Triturus cristatus</i>	T1	v: 4	
C.2i	1 Introduced population of <i>Bombina variegata</i>	T1	v: 1	
C.3	implementing permanent nature	T2	v	The project allowed going over the initially planned objectives for permanent nature allowing to secure habitats and long-lived species populations in disused areas of quarries. T
C.3a	24 Permanent ponds	T2	v: 143	
C.3b	400 m of slopes for reedbeds installation	T2	v: 682	
C.3c	16 Tern platforms	T2	v: 8+22+1	8 tern platforms were completed by 22 Smaller platforms and 1 islet
C.3d	4 Secured galleries for chiropters	T2	v: 12	
C.3e	50 ha of grazed grasslands	T2	v: 29.54	
C.3f	10 ha of mowed grasslands	T2	v: 78.63	
C.3g	200 m of Last blasting	T2	-	Action was not implemented as a result of a lack of opportunity and of security concerns
C.3h	8 km of linear screes	T2	- : 5437m	Lower implementation was linked to fewer opportunities to develop the action than expected and important related costs.
C.4	Generalizing locally (12 sites) / internationally (to 6 quarries)	T1, T2	v: 13 / 7	The generalization at the Walloon level was successful with 13 new quarries joining the process. At the EU level, 3 countries were visited and proposed actions welcomed by the 7 visited quarries.
D.1	Monitoring temporary nature tests	T1	v	Longer implementation of monitoring allowed taking withdrawal and better understanding outcomes of test actions
D.2	Monitoring biological outcomes	T1	v	The biological monitoring allowed confirming the interest of actions to conserve biodiversity within active areas of quarries. It also provided positive outcomes for the installation of all 3 introduced amphibians and most a wide diversity of introduced plant populations.
D.3	monitoring ES at large scale	T2	v	The ES monitoring allowed better understanding trends in ES in the life cycle of quarries allowing for conscious choices in rehabilitation.
D.4	An adopted basic monitoring	T4	v	The Basic monitoring (AMBRES) platform and tools developed allowed for a practical tool and for an adoption of the monitoring process facilitating a stewardship of biodiversity and commitment under the charters
D.5	Redaction of charters	T1, T3, T4	v: 25 (26)	A type charter was redacted and successfully adapted to 25 (+ 1 expected) quarries allowing for a long-term commitment of quarries
D.6a-b-c	A socio-cultural initial and final survey	T5	v	The Consciousness study allowed confirming the impact of the project and a raised interest and awareness of the sector for target biodiversity It was completed by an analysis of cost related to temporary biodiversity management in quarries
E.1	28 notice boards at strategic communication place	T4	v: 60	Large boards allowed for a visibility of the project within all sites.
E.2	A website	T4	v	Along with other media, the website reached its objective of disseminating the philosophy of the project.
E.3	Networking	T4, T5	v	Networking with LIFE and other project have led to rich encounters with reciprocal exchanges of information and methodologies.
E.4	A Layman's report	T4	v	The Layman report, delivered in FR and EN is expected to be broadly disseminated by FEDIEX and its partners over the next few years. It will likely act as an important communication tool for the sector.
E.5a	Training of CEOs, biodiversity responsible, worker	T1, T2, T4	v: 15 CEOs, >36 responsible, 239 workers	The training at all hierarchical positions allowed raising awareness, capacities and stewardship of the main actors: quarries staff

Action	Foreseen in the proposal	Targets	Achieved	Evaluation
E.5b	Training of Administration	T1, T2, T4	v	Onsite visits with the DNF and multiple exchanges with DEMNA allowed facilitating exchanges and the adoption of the LIFE in Quarries by public servants
E.5c	1 Methodological document	T1, T2, T4	v	Though arriving later in the process than expected, the Guide, by consigning the acquired knowledge of the dynamic management of temporary nature, will allow providing resources to the quarries at both local and EU level
E.5c	10 Factsheets	T1, T2, T4	v: 11	Factsheets allowed both providing information on management and summarizing the first consideration of the LIFE in Quarries team in practical documents.
E.5c	5 Videos clips	T1, T2, T4	v: 6	High quality videos have been praised and (will) serve as an ideal training and communication tool
E.5c	An online picture database	T1, T2, T4	v	The integration of the species picture database to the AMBREs platform will allow further raising knowledge of quarry personnel to species. The large amount of pictures taken over the project helped richly illustrate the deliverables of the project.
E.5d	Training of EU partners	T1, T2, T4	v	The training of EU Quarries not feasible as originally planned was however possible by raising awareness and providing specific advices during C.4b visits
E.6a	10 Newsletters	T4	v: 10	The newsletter allowed disseminating to a broader audience the main progresses of the project.
E.6a	General folder on the project	T4	v	The general folder has been useful as an initial tool presenting the project in a diversity of events
E.6a	Communication campaign	T4	v	The communication campaign benefited from committed staff that helped diffuse the project outcomes through a whole diversity of channels.
E.6b	3 Observation platforms	T4	±: 1 (3)	Unexpected delays led to the finalization of 1 of the three observation platforms. The commitment of quarries to realize the additional 2 on own funds in 2022 should compensate this discrepancy.
E.6b	72 Open quarry days	T4	±: 46	The combined effect of an ambitious initial objective and Covid-19 crisis led to a reduced number of visits with groups that are more specialized. Impact is expected to be compensated by the large dissemination campaign
E.7	6 EU working group	T4, T5	±: 3	While the number of working group was lower than expected, the dissemination at EU level was completed through a diversity of other channels
E.8	An international workshop	T4	v	Though in hybrid version and delayed from the original plans, the Final workshop attendance met the project's expectations and the quality of presentations helped summarize the main outcomes of the project.
F.3	An After-LIFE plan	T5	v	Along with charters, the After-LIFE plan should allow maintaining commitments alive and provide support and commitments for further realizations.

VI.3.3. Monitoring of project results

D. actions have led to a monitoring of concrete conservation actions as well as of other achievements of the project.

Action D.1 allowed monitoring rapid outcomes of temporary nature test actions though inter-annual variability in climatic conditions led to a necessity to extend the monitoring to allow to catch the outcomes of the project.

As for D.1, the Biological monitoring of temporary nature actions (C.2) under action D.2 provided fast feedback after two years of implementation but the 2020 monitoring allowed confirming/infirming trends and grab a more complete pictures of successful actions. Permanent nature actions take, by definition, more time to deliver results. This led to some difficulties in interpretation of results but as shown by the permanent ponds experience and from the detailed studies on grasslands, while first hosting pioneer species typical of

temporary nature, with adequate management habitats slowly but surely evolve towards typical habitats of interest for target species.

The Ecosystem services analysis undertaken under action D.3 informs on the difference in the time required to identify results for the different categories of ES. While Cultural services increased rapidly as a result of the project implementation leading to awareness being raised among actors, Regulation and Provisioning services present a higher inertia linked to the development of the quarry rather than to the LIFE in Quarries actions. Provisioning services can have however seen indicators evolved as a result of the implementation of grazing and mowing regimes.

As for D.1 and D.2, the temporary nature actions monitored under the basic monitoring (D.4) are quite responsive. This has likely participated in the appropriation of the monitoring by quarry staff, as outcomes of actions implementation are often directly visible even to non-naturalist expert. While the initial formula of monitoring was not well accepted by quarries, the development of the didactic AMBREs platform has boosted adhesion with a 100% of all quarries using the tool in 2021. The long-term appropriation of the monitoring should be guaranteed by regular training expected under the After-LIFE plan (F.3).

With 26 management plans and 25 (+1) charters being adopted by the participating quarries under action (D.5), the adhesion to the scheme developed is a proof of short-term completion of one of the main objective of the project and is a good omen as they commit the quarries to maintain actions that have proven successful in a win-win situation. Long-term impact will be allowed to be monitored on a 5-years basis.

The project aimed, along with concrete conservation action, to raise the awareness of quarry personnel on the importance their site represent for pioneer biodiversity and on sound actions to implement to favor relevant target species. The outcomes of the Consciousness study under action D.6b demonstrated that even though the sector was already aware of biodiversity in quarries, the LIFE in Quarries led to a better understanding of stakes at play and to an evolution of its relationship to nature.

VI.3.4. Effect of Project amendments on the delivery of the project

Five amendments were brought to the original Grant Agreement. Of these, 2 consisted in administrative adjustments and 1 in the addition of 2 new sandstone quarries (Amendment #2) while these did not significantly impact the results achieved, the addition of 2 quarries allowed securing the results of the project.

Of higher impact, Amendment #4 approved a 12-month that appeared necessary as a result of delays accumulated in link with the complexity of the project. Among others, the extension allowed developing a solid strategy for the long term commitments under the management plans and charters taking into consideration the important processing time linked to the high number of derogations introduced (D.5), as well as to provide time for the development of the AMBREs platform (D.4) and its adoption by affiliates and a strong communication allowing for the dissemination of the project outside but also within the sector (E. actions).

In association to the three month extension of Amendment #5 linked to delays related to Covid-19, it allowed for the project to disseminate its outcome abroad (C.4) and to finalize important deliverables such as the methodological document under E.5c.

VI.3.5. Replication efforts

The replication effort under action C.4 - Generalisation at Regional and International level took place at two levels: regional and EU.

Results of the **regional** replication, i.e. in the 13 Phase II.1 and II.2 sites (sub-action C.4a) are an important part of the project and are presented along with outcomes of C.2 and C.3 conservation actions under action D.5: Table 12. Synthesis of C.2 to C.4a realized and committed project quarries as of the finalization of management plans.

The dissemination **at the EU level** is presented in sub-action C.4b. The sub-action led to the visit of seven sites in three EU-countries to propose actions for implementation. Because of the delayed timing of implementation of sub-action, actions are not documented yet but commitments to try to implement some of the proposed actions are expected to deliver results. Broadly, outcomes have however been somehow limited by the legal uncertainties still present in particular in Germany and France linked to the dynamic management of temporary nature.

VI.3.6. Effectiveness of dissemination

Dissemination activities have been a key element of the LIFE in Quarries project as the final objective was to integrate durable biodiversity management measures in the daily management practices of quarry operators.

Within the project, the implementation of the validated actions under C.2 to C.4a was tributary of adequate training provided under action E.5 that led to the development of specific training modules. In addition to C. actions implementation resulting successful, these allowed a better appropriation of the Basic monitoring under D.4. and further understanding of the content of management plans and charters. Informal training was also a result of the presence of the project's team on-site, guiding and transferring knowledge in bilateral exchanged with quarry responsible.

Externally, the dissemination of the project can be concluded as successful. Details of dissemination activities are presented in E. actions

The LIFE in Quarries project has seen a large number of communication being disseminated through channels on which it had control (Notice boards, Website, Layman's, Final workshop, FEDIEX's Quadraria mag) but also through channels tributary of external stakeholders. Dissemination went through:

- Networking leading to high number of exchanges;
- On-site exchanges with the DNF leading to informed public servants;
- High visibility of videos thanks to an appropriation of the content and diffusion by the "Jardin Extraordinaire" with a premiere at a Nature Film festival;
- Multiple reportages and newspaper and scientific vulgarization articles;
- Multiple exchanges both formal and informal with sister federations;
- Spontaneous requests for presentation of the project through conferences and site visits from external actors;
- Interest in Open quarry days visits;
- ...

The delivery of outcomes over the last year of the project has helped substantiate the content of the presentation with facts and figures demonstrating positive outcomes of the project likely explaining the increasing interest felt by the project partners and affiliates.

VI.3.7. Policy impact

Extensive legislative analysis of the concept of "Dynamic management of Biodiversity" and EU comparative study, undertaken under action A.4a, waived a number of expected legal barriers to the implementation of C-actions by providing a way to manage biodiversity in ad equation with the Habitats Directive.

At the regional level, this led to an administrative circular that helped the regional administration for the delivery of derogations to the regional transposition of the Habitats Directive with a plan-based approach.

At the EU level, the project fed the recent sector's Code of Conduct aiming at conducting the management of protected species at the EU level with a practical case study allowing to which the Code referred as a way for implementation.

The LIFE in Quarries contribution in the development and implementation of the Temporary nature concept also led to the project being referenced as a case study in the Commission 'Guidance document on the strict protection of animal species of Community interest under the Habitats Directive' (C(2021) 7301 final - 3.3.5. Temporary nature: dealing with the colonization of sites under development by species listed in Annex IV) with a proposed process of implementation close to the scheme developed under the LIFE in Quarries.

The LIFE in Quarries has thus achieved one of its goal: to “**demonstrate that Habitats and Birds Directive can accommodate the dynamic approach required to manage fugitive biodiversity**” (GA – Form B3). Some EU Habitats, and in particular freshwater (31**) and grassland (6***) have benefited from the adequate management plans of the project,; this outside of the N2000 network favoring the development of connectivity complementing the N2000 network and thus favoring the development of Green Infrastructure.

VI.4. Analysis of benefits

VI.4.1. Environmental benefits

a. Direct/quantitative environmental benefits

Target 2 of the EU Biodiversity Strategy aimed at integrating actions to maintain and enhance ecosystems and their services into the activities of the private sectors, by establishing Green as well as Blue Infrastructure and restoring degraded ecosystems. At the regional (Walloon) level, the Priority Action Framework (PAF) set priorities to restore sites inside **and outside** the Natura2000 network and insists on the importance of the role of active quarries in maintaining pioneer habitats.

The LIFE in Quarries project answered these objectives by maximizing quarry biodiversity hosting capacity and steppingstone's role in the ecological network with actions integrated in the daily activities of the private sector.

As far as Natura2000 habitats, the project secured numbers, linear and surfaces of ponds, grasslands, vertical faces, shelters ... representing EU Habitats Directive (analogous) habitats. Outcomes presented under action D.5 and summarized in both Table 12 and Table 16 will help to contributing to the EU N2000 objectives and the regional PAF for habitats including EU habitats 31340, 3150, 6110, 6210(*) and 6510. For both pioneer and permanent habitats, the project has allowed to develop connectivity outside of the N2000 network with quarries completing able to confirm their role of completing the regional Green Infrastructure in areas for which any legal protected status does not appear relevant.

In doing so, the project also secured habitats availability for N2000 species complementing the securing of "semi-natural populations" outside of designated sites. Species populations of pioneer Natterjack Toad (*Bufo calamita*), Little ringed plover (*Charadrius dubius*), Sand martin (*Riparia riparia*), Midwife (*Alytes obstetricans*) and long-lived Great crested newt (*Triturus cristatus*), Wall lizard (*Podarcis muralis*), Smooth snake (*Coronella austriaca*) are thus expected to maintain and/or develop their populations on quarries committed through a management plan.

The project outcomes not only worked with N2000 species, but it also secured regionally endangered species population such as dragonflies: Southern skimmer (*Orthetrum brunneum*), Keeled skimmer (*Orthetrum coerulescens*), Small bluetail (*Ischnura pumilio*) and Common Winter Damselfly (*Sympecma fusca*) or solitary bees and other species of reptiles as the Grass snake (*Natrix natrix*).

By seizing opportunities for the development of new populations of amphibians and heritage flora (C.2f to C.2i), the project wished to demonstrate that, by over-passing physical barriers preventing natural colonization of sites, it could develop new core populations that would then be able to disperse in the landscape. 9 populations of N2000 amphibians (*Bufo calamita* (5), *Triturus cristatus* (4) and *Bombina variegata* (1)) were thus introduced and first reproducing adults are encouraging in saying that populations have installed already after 2 years.

b. Qualitative environmental benefits

The project is working at enhancing Nature outside of the Natura 2000 sites thus complementing the network and avoiding that the Natura 2000 sites become isolated 'islands of nature'. LIFE in Quarries actions working on target umbrella species so that the project will have a positive impact on other species as well.

The After-LIFE plan further aims at increasing this availability of habitats with 26 quarries that will continue the implementation of their biodiversity management plan. 3 new quarries are expected to join the process over the next five years as a sector's commitment. In these quarries, an estimation of a potential evolution in concrete conservation actions realizations was based on 2 assumptions:

- Temporary nature
 - An additional 3 quarries leading to the development of temporary nature realizations (C.2 actions);
 - Expected outcomes are evaluated as a pro-rata: $[\text{Achievement on 27 sites}] * 3 [\text{new sites}] / 27 = [5 \text{ years expectation}] \text{ new potential}$;
- Permanent nature
 - A 10 % increase in the post exploitation restorations (C.3 actions) of the 26 quarries and the development of permanent nature in 3 quarries leading to the development of permanent nature realizations.
 - Expected outcomes are evaluated as a pro-rata: $([\text{Achievement on 27 sites}] * 10 \%) + [\text{Achievement on 27 sites}] * 3 [\text{new sites}] / 27 = [5 \text{ years expectation}] \text{ new potential}$;

A best estimate for evolution is provided in Table 17 with new room for species and habitats expected to be developed over the next 5 years. Means will mostly come from the sector but also from (continued) collaboration with other incentive EU policy have helped or will help to ensure long-term management such as:

- Agri-environment measures that help attract farmers and herders for long-term pro-biodiversity management of mowed (C.3e) and grazed (C.3f) grasslands;
- Walloon Rural Development plan that should, in the future, offer funding possibilities to further restore biodiversity in quarries as well;
- Work with other LIFE project as has been done with the LIFE BELINI (see E.3) to develop a coherent connected habitat for the reintroduced Great crested next population in the Contrat Rivière Senne territory.

Table 17. Best estimate of actions evolutions over the After-LIFE.

Action	End of project	5 years on
C.2a - Pioneer ponds (n)	403	448
C.2b - Pioneer grasslands (ha)	30.75	34.25
C.2c - Sand banks for solitary bees (n)	18	20
C.2c - Vertical faces for sand martins (n)	14	15
C.2d – Shelters (n)	403	448
C.3a - Permanent ponds (n)	143	160
C.3b - Reedbeds (km)	0.68	0.81
C.3d - Securing bat galleries (n)	12	14
C.3e - Mowed grasslands (ha)	29.54	35.75
C.3f - Grazed grasslands (ha)	78.63	94.87

The overall impact of the project is positive on nature & biodiversity as the LIFE in Quarries' actions have been implemented in 27 quarry sites across Wallonia. The biological monitoring undertaken in 2018 and 2020 under action D.2 confirmed the expected outcomes of the project on main the five biological groups (plants, amphibians, reptiles, birds and dragonflies) and helped further clarify them. The creation of temporary habitats under C.2 and equivalent in C.4a has had direct visible positive impact on the pioneer targeted species. For permanent nature, the evolution of long-lived species and permanent habitats is expected to evolve favorably as a result of restoration undertaken under actions C.3 and equivalent in C.4a.

The project has brought solutions to the original threats identified in the grant agreement:

- **Threat 1 – Lack of awareness:** It raised the sector's awareness of the sector through trainings and presence on site. Brought Public servants on sites as well to exchange and demonstrate the outcomes of implemented actions (see action E.5b) and helped disseminate the role quarry can play towards the Laymen (under E. actions). The raised awareness is expected to be fruitful.
- **Threat 2 – Permanent availability of temporary habitat:** Resources in temporary habitats temporarily set aside in refuge areas improves habitat availability for target species through C.2 actions and commit quarries to maintain these over the long term (action D.5); evolving in their location within the quarry.
- **Threat 3 – Legal interpretation of temporary nature concept:** Rather than bringing new problems, the project aimed at bringing solutions by providing legal solutions under action A.4 that brought legal certainty to the dynamic management of biodiversity with successful implementation demonstrated through action D.5. By bringing this legal certainty, the framework implemented to the 26 sites is expected to further become an incentive to develop biodiversity in new sites in a win-win situation.
- **Threat 4 – Incompatibility of nature with legal requirements:** As for temporary nature, action A.4b only resulted in the identification of minor incompatibilities between nature and existing permits. Threat 4 proved not so relevant when Threat 3 had been waived. However, for permanent nature, the short time-span of the project compared to the one of a quarry did not allow to evaluate the overall potential to restore quarries upon finalization. The “how” and the “what” would likely benefit of further considerations.
- **Threat 5 – Isolation of wildlife in the landscape:** The project demonstrated that ways around can be found to favor colonization of interesting habitats (actions C.2f to C.2i). Though in many sites target species were pre-existing, the introduction of amphibians and flora is an interesting case study demonstrating that room has been made for the development of new species' populations. We can expect in the future that, through passive colonization, increased connectivity resulting from other projects or introduction, quarries having developed interesting habitats would be colonized by more target species. A collaboration in that direction has been launched by FEDIEX with the agricultural sector.

VI.4.2. Economic benefits

LIFE in Quarries' objective was to demonstrate that operational solutions for biodiversity management can be implemented through limited investments benefiting both stakeholders interested in nature and the private sector. The analysis of extra costs related to the management of biodiversity D.6c defines for all 3 stages of implementation of temporary nature management and for all actions, expected **internal human resources, machines resources** and **financial resources (including expertise)**. These will allow for the estimation, by a quarry manager - based on internal costs - of overall expected costs that would result from biodiversity management within its own site.

Though a precise monetary evaluation was not provided, the implementation of permanent nature actions in quarries benefited from the presence of personnel and machines on sites and confirmed a much better cost-efficiency in comparison to conservation works that would take place in a natural environment and would lead to additional cost linked to bringing human resources and machines.

Hence, while a cost is to be associated to the development of nature in active quarries, its importance appears as acceptable for the implementation to a broader extent with high beneficial outcomes.

The project led to the creation of c. 6.65 FTE during the project. In the After LIFE, this number should evolve towards an estimated value of 2.25 FTE with (as referred in action F.4 – KPIs):

- AMBREs platform management: 0.2 FTE
- Requested Support to the ABs and other biodiversity stakeholders from quarries in the implementation of charters: 0.2 FTE
- Quarries workers working on nature management : c. 5 days.men a year * 26 quarries /220 = 0.6 FTE

- Quinquennial monitoring: 26 * 10 days.men = 1.25 FTE

Not taken into account into KPIs:

- In addition, a surface of c. 100ha being returned to herders or farmers, these ha will likely generate some revenue to be translated into FTE. A hectare allowing for an indemnity of 450 euros/ha as for Agri-environmental scheme (MAECs) we could translate this into c. 45 000 euros/year (+ linked first pillar primes), i.e. 0.5 to 1 FTE.

VI.4.3. Social benefits

Action D.6b – Socio-cultural monitoring of communication actions / consciousness of the sector for biodiversity allowed measuring the impact of the project on the main stakeholders involved: the quarrying sector personnel. In doing so, it demonstrated the positive impact of the project on employees as they showed interest in developing and protecting biodiversity on their sites while still maintaining the activity.

The resulting feedback is encouraging for the long-term viability of the project as, when trained adequately, quarries' staff can become stewards of their sites' biodiversity.

It is expected that this appropriation will play a role in the well-being of staff and indirectly, positively influence of employees through the health effect of encountering nature at work, as part of Cultural ES (see also D.3 - ES evaluation).

The project has also developed new contacts between quarries and local and regional stakeholders through

- the implementation of grazing/mowing by herders and farmers now regularly accessing the sites (C.3e and C.3f);
- the established contacts with local and regional DNF public servants (E.5b);
- neighbors and local naturalists visiting through Open quarry days (E.6b);
- intern students realizing master thesis or internships in the quarrying environments;
- social networks exchanges through the Facebook, LinkedIn and Instagram account of the project (E. actions);
- ...

While a side-effect of the project, these encounters around a positive subject are likely to provide further benefits in the future by facilitating discussions and promoting a mutual understanding. Project's actions are indeed expected to have had a strong social impact on the general public perception of quarry activities and compatibility with biodiversity conservation.

Another side-effect of the project has likely been the mutual-understanding that has been operating throughout the project between an NGO, a Nature Park, a University and private companies. The mentalities evolution of the LIFE in Quarries' staff and quarries throughout the project result in a better acceptance of both 'naturalists' in the extractive world and in a recognition of the role the sector can play for biodiversity by these same naturalists and scientists. The reaching of most of the objectives of the project is also expected to be a factor influencing the well-being of the large diversity of stakeholders involved.

Collaboration is expected to be continued in the After-LIFE through, among others:

- A continued exchange in a version 2.0 of the Steering committee (meeting once a year to exchange on the evolution of the project);
- 27 site's visits (minimum 1 per quarry over the five next years);
- At least 2 new master thesis/interns involved with ABs in quarries over the next 5 years;
- 70 newly trained staff in quarries;

VI.4.4. Replicability, demonstration, transferability, cooperation

LIFE in Quarries is a **demonstration** project, intimately structured in several phases to reveal its demonstration character. Through 2 phase and a dissemination at the EU level, it demonstrates that it is **replicable and transferable** to other regions/countries or even to other sectors.

The innovative approach of the project has raised a lot of interest among stakeholders at regional and European level. Specific aspects are extensively discussed such as the compatibility of nature conservation on industrial grounds, the partnership Private companies – University, NGO's, the legal approach...

Other federations, international companies and regional authorities have all shown an interest to launch a similar project in their country. Such positive returns are highly valuable for the dissemination of the project results at EU level. The generalization phase at international level has further increased the dissemination outside of the Walloon region. This is also the case for the recent sector's Code of Conduct. By committing to a biodiversity management approach at the European level, the sector wishes to generalize the knowledge gained from the many case studies of biodiversity development on its sites. The LIFE in Quarries provides a concrete implementation formula for this desire in a process compatible with the Habitats Directive.

We can thus expect that the outcomes of the project will further serve for the appropriation of the biodiversity management by the sector should (i) regional/national authorities and administrations favor the way forward; and, (ii) the public demand for green credentials influence the commitments of the EU sector. Likelihood of replication is set as high, both as a market-driven demand and as a result of favorable policies.

Cooperation with other project has also helped raise the awareness for the restoration potential of post-exploited areas. This is for example the case for the LIFE Connexions (LIFE19 NAT/BE/000093) interested in implementing future restoration in sites that could not be taken in charge by the LIFE in Quarries.

VI.4.5. Best practice lessons

Best practices for biodiversity management in active quarries - first compiled from an extensive literature review and direct contacts with specific stakeholders, then tested under the pilot phase, and finally reproduced adjusted and validated in the second phase of the project – have been synthesized in the methodological document developed under action E.5c. The strategy and actions proposed might need some adjustments in other bio-geographical contexts as shown in the visits of Mediterranean quarries in Spain during the Generalization phase (action C.4b) but the evolution in the interpretation of temporary nature could also provide further potential for actions in the future.

VI.4.6. Innovation and demonstration value

Though working on pre-existing basis, the project has led to major innovations in the practical implementation of temporary nature management under action C.2 and its generalization under C.4:

- The development of a reproducible framework for the implementation of temporary nature management in quarries and its implementation on 27 sites represents an important achievement of the project;
- The transfer to 7 quarries already benefiting from extensive biological inventories demonstrates that the framework is adaptable and can benefit from previous knowledge;
- The legal certainties provided allow for the methods to be applied at a broader scale (A.4);

The project has also innovated in the means used to favor stewardship for biodiversity by the sector and to facilitate the appropriation of these nature management methods. It innovated in:

- Providing adapted training at different hierarchical levels (under E.5a);
- Developing an online management platform allowing for an internalization of the monitoring of implementation and outcomes by quarries (under D.4);

These innovations are expected to outlive the project in the After-LIFE with:

- At least 3 new quarries expected to join the process and apply the project's framework leading to long term commitment (following the sequence of actions A.3 - C.2/C.3 - D.5);
- An expected 2 training sessions (following implementation in E.5a) provided over the next five year to allow new staff to be trained to biodiversity in quarries by using the outcomes (under E.5c) of the projects and the project's quarries as demonstration sites;
- The continued implementation of the Basic monitoring in the project's quarries using the AMBRES platform (developed under D.4);
- A continued dissemination of the project outcomes.

VI.4.7. Policy implications

The project outcomes and methodology, already set in the specific context of the Walloon region could be transferred to a broader extent, delivering both for dynamic management of temporary nature but the project outcomes could also benefit policy makers to integrate quarries networks into pre-existing or in-development Green Infrastructures.

Indeed, the contribution to the Green Infrastructure of the project has often been under the spotlight with specific intervention in INTERLIFE, requests for methodological guidance from other Walloon project, ... The final report on ***the Ecosystem services assessment in the Extractive sector LESSONS from the LIFE IN QUARRIES PROJECT*** under action D.3 helped determine that **"quarries can thus contribute to the development of Green/Blue Infrastructure especially in highly anthropogenic, homogenized landscapes"**.

*They can indeed act as important places for the **regulating service** 'Maintenance of habitats for species life cycles', as stepping stones for species with high dispersal capacity (dragonflies, pollinators, bats, birds) or even core habitats for populations of less mobile species (e.g. amphibians). In this context, quarries can bring an interesting contribution **to the connectivity of Natura 2000 Network outside N2000 sites.***

*Through their ecosystemic diversity, **quarries can diversify the offer of provisioning services in homogeneous landscapes**: 'Commercial crops' and 'breeding' production in non-exploited and restored areas.*

*The importance of **cultural services** highlighted in this assessment supported the fact that **quarries are also opportunities to connect people to nature** in biologically impoverished landscapes by increasing ES related to 'Sources of experience and knowledge' and 'Natural space and biodiversity sources of intrinsic values of existence and heritage'." (Action D.3).*

Though not yet present appearing in policy reports to our knowledge, we hope that the acquired knowledge and methodology applied will serve future projects in their understanding of how a network of sites and/or private actors can contribute to the development of a Green Infrastructure without forgetting that the outcomes of the project could also be transferred to other sectors of activity.

Finally, the evolution of the sector consciousness is expected to have a positive impact on other actions among which some searching for win-win situation for nature and human. By becoming actors of nature at work, economic stakeholders can become true stewards and protector of THEIR biodiversity.

VII. Key Project-level Indicators

Initial and final evaluations of the Key Project-level Indicators were both performed under action F.4. They include a best guess estimation of expected evolutions as a result of the implementation of the After-LIFE referenced under action F.3.

As the KPIs online database evolved throughout the timeframe of the project (initially filled in Excel spreadsheets), the KPIs referenced at the beginning of the project evolved as well so that a comparison of initial and final targets does not appear as relevant. However, as summarized in section VI.3.2 , we believe that the realizations of the project have demonstrated the overall achievement of its initial objectives.

VIII. Comments on the financial report

VIII.1. Summary of Costs Incurred

Costs incurred are summarized per categories in Table 18.

Table 18. Summary of costs incurred per category

Cost Category	Budget (GA)	Costs incurred	%
Personnel	€ 2 789 930.00	€ 3 372 532.83	121%
Travel	€ 265 856.00	€ 131 974.86	50%
External assistance	€ 1 175 940.00	€ 778 963.78	66%
Infrastructure	€ 388 200.00	€ 292 330.48	75%
Equipment	€ 40 200.00	€ 28 283.45	70%
Prototype	/	/	
Land Purchase / Lease / One-off compensation	/	/	
Consumables	€ 110 272.00	€ 278 381.32	252%
Other direct costs	€ 5 000.00	€ 37 096.99	742%
Overheads	€ 260 790.00	€ 290 492.76	111%
Total	€ 5 036 188.00	€ 5 210 056.46	103%

VIII.2. Accounting system

Internal financial rules were defined at the early stages of the project by the coordinating beneficiary to facilitate the budget coordination and follow-up.

VIII.2.1. Tendering rules

Internal tendering rules were defined on basis of the public procurement rules of the Walloon region. Associated beneficiaries keep all supporting documents to justify the tender procedures for the selection of suppliers/subcontractors. All non-budgeted expenditure or costs above tendering value (> 1,250€) had to be approved by the coordinating beneficiary.

Framework contracts of affiliates running before the start of the project are considered to have been selected according to an adequate market analysis for competitive prices. Due to confidentiality reasons, FEDIEX may not have access to the supporting documents, but these are available upon request of EASME at each affiliate.

VIII.2.2. Invoicing

All beneficiaries controlled their invoices concerning the presence of the LIFE code and verified amount and eligibility. For each purchase and service, it was specifically demanded to put the project's reference on the invoice. In case of impossibility, the invoices were stamped upon quality check.

Invoices were paid by the respective beneficiaries who archived originals and sent scanned copies to the coordinating beneficiary along with their financial statement every semester.

Due to confidentiality reasons, FEDIEX may not have access to invoices of affiliates for external assistance, but these are available upon request.

VIII.2.3. Beneficiary's internal accounting system

Beneficiaries/affiliates use their internal analytical accounting system in accordance with normal accounting conventions imposed by law and existing regulations.

VIII.2.4. Time registration

Associated beneficiaries

Internal rules were defined with a unique time registration system for all beneficiaries. The timesheet was elaborated based on the LIFE template with some practical adaptations. The timesheets were filled in for daily activities by all beneficiaries. On a monthly basis, electronically signed timesheets and scan of signed version were sent to the coordinating beneficiary. Original copies are kept at the beneficiary.

This system enabled the coordinating beneficiary to have a regular overview of the time spent on the project.

Affiliated quarry partners

A similar individual time registration system was filled in by all quarry partners and sent to FEDIEX:

- Personnel timesheets. No timesheet is filled when the person is not active during a month.
- External assistance and consumables timesheets – to register machines and raw materials used to implement conservation actions onsite. No timesheet is filled if there is no activity.

On a monthly basis, electronically signed timesheets and scan of signed version were sent to the coordinating beneficiary. Original copies are kept at the affiliates offices.

VIII.3. Certificate on the financial statement

The approved auditor who established the certificate for payment of the balance is

CdP De Wulf & Cie. SCPRL (n° BE00366)

Contact: M. Vincent De Wulf, registered Auditor, Partner

Address: Rue de l'Hospice Communal 6, B-1170 Bruxelles

Tel : 02/663.11.20

Mail : v.dewulf@cdp-partners.be

VIII.4. Estimation of person-days used per action

To have an overview of the use of budgeted person-days by group of actions, Table 19 summarizes estimated % of person-days spent. As mentioned, budget has been modified and particularly amounts available in other cost categories were used to cover personnel for the prolongation. This explains deviations from the budget. The evolution can also be linked to a higher number of affiliate quarries as well as to original under-estimation of human resources that would be dedicated to the assistance in training and in implementation of actions. Finally, the 15 months extensions of the project is a main reason for discrepancies with the original proposal.

Table 19. Summary of estimated % of person-days spent by group of actions.

Action type	Budgeted person-days (GA)	Estimated % of person-days spent
Action A – Preparatory	1513	131%
Action C – Concrete conservation	2337	114%
Action D – Monitoring	1526	133%
Action E – Communication	856	148%
Action F – Project management	1085	146%
TOTAL	7317	130%