From limestone quarry to Biodiversity Production: La Medina

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ABSTRACT

La Medina is a limestone quarry located in the council of Oviedo, between Sograndio, Priorio and Santa Marina de Piedramuelle, and 7.1 Km far from the capital (see Appendix I). Since the quarry started its activities 40 years ago, the deterioration of the area is obvious and a restoration plan is needed to be carried out as soon as we can, because the extraction will continue a few decades more.

This project, titled "***From limestone to Biodiversity production: La Medina***", intends to promote biodiversity in the area of the quarry, looking for the settlement of the native species and increasing the natural wealth of this environment, through sustainable and respectful ways.

To make this possible, we propose the restructuring of the quarry at different levels, allowing the reconditioning for both, flora and fauna.

At the same time, knowing humans affect natural life in different ways, we want to encourage environmental education through a series of guided activities. In that way, we promote biodiversity directly but we will also make aware local people about the importance of the sustainability of the quarry and the respect for nature.

Summing up specifically, the main points our project is established on are:

- "Biodiversity units" creation, as structures o specific zones destined to facilitate the settlement of animal species. "Bee hotels" for insects, pond area, clefts on the slopes for bats or nest boxes for birds are some of our proposals.

- Plague species eradication; it's a necessary step and we can apply it immediately. It would consist on the location and identification through transects and, subsequent elimination, of two exotic, invasive and very abundant species: pampas grass (*Cortaderia selloana*) and eucalyptus (*Eucalyptus globulus*) (see Appendix II), which compete with native chestnuts and cause a biodiversity reduction because of the excessive nutrients and water use.

- Vegetal repopulation of the basal zone with a combination of different native species; we propose a list of species that we consider suitable after the studies we have carried out during the last months. We will also promote the restoration of the vegetal cover on the slopes of the quarry through hydroseeding (on the ledges) and the adaptation of the slopes, though holes drilled and clefts, as feasible paths of action.

- Construction of a footpath around the quarry for the establishment of the "Environmental route", from where the visitors could observe the area and the results of the activities, and appreciate the existing diversity through information panels.

- Environmental workshops impartation, where, under the supervision of an environmental expert, different activities will be performed at the same time that the importance of respecting the environment is made aware. Talks, guided visits through the footpath or the construction of biodiversity units on workshops are some examples.

To sum up, this is a project with many paths of action, all of them viable and, if all of them are successful, they will have a very beneficial impact on the company, on the environment and on the biodiversity of the area.

INTRODUCTION

The project described below, "*From limestone quarry to biodiversity production: La Medina*", is an initiative of a group of five biologists from the University of Salamanca through which, and thank to the opportunity offered by Hanson (*Heidelberg Cement Company*), we wish to expose our ideas and our modest knowledge in order to help to preserve the biological values of "La Medina", selected as participating quarry this year in the *Quarry Life Award* program.

We would like to express our gratitude from these lines for the effort of the company and their interest in preserving the biodiversity in their mining areas, as well as for the opportunity they provide for young scientists to contribute to this objective. We have the honor of participating in this *Quarry Life Award* edition, and we hope that any of our proposals will be included in a project with such a laudable purpose.

OBJECTIVES

Before starting to explain the project, we would like to mention our main objectives:

- Firstly, *maintain* or even *increase the mining area biodiversity*, through different action plans involving the management of wildlife.
- Secondly, use this quarry to *educate the population* in respecting the environment and the importance of preserving the biodiversity in the environment; raising awareness about the benefits of a high biodiversity in every ecosystem is sought, as well as the compatibility between environment exploitation and the maintenance of its species richness. This learning is crucial to ensure that this environmental respect is something lasting and for several generations to come.

PROJECTED ACTIONS

The different paths of action proposed in the project are described below, detailing the expected different action plans in each one of them.

FAUNA RELATED ACTIONS

One objective of this project is to enhance the biodiversity of the environment maintaining a high the number of plant and animal species present in the area and, consequently, the complexity and richness of the ecosystem. This project stands for, instead of importing exotic species, favouring the maintenance of the native fauna, already living in the environment, that sometimes is highly representative of the region.

With this objective, and focusing on the diversity of local fauna, the concept of "Biodiversity units" has been developed, which could be defined as "areas, natural or artificial constructs structures that serve as niches for specific groups of animals facilitating their settlement there".

Having in mind the potential fauna and the materials and tools available, the following biodiversity units are proposed to be established in La Medina:

- **Bee Hotels:** to encourage the presence of pollinating Hymenoptera in the area of La Medina, one kind of biodiversity units proposed are *Bee Hotels*, consisting of many tubes with different diameters (usually bamboo or hollowed logs) (see Appendix III), allowing the entrance to bees and solitary wasps inside it. Once there, they develop their full life, laying their eggs on these tubes; this provides a high level of protection to the preimaginal stages for the insect, until eclosion occurs.
  Some issues to be considered when building the hotels are the orientation (must be oriented towards the sun to facilitate the reception of solar heat), height (believed that the ideal is around a meter high) or the need to protect from the rain (using oblique wooden canopies). Moreover, the existence of aromatic and non aromatic plants that attract these species (naturally or through planting) is recommended to start the settlement.
  These structures are currently booming, both for investigating certain groups of solitary Hymenoptera and looking for the benefits, provided by them, by people or companies.

- **Drilled logs:** the same way *Bee Hotels* can serve as biodiversity units, drilled logs can also be helpful for the settlement of various invertebrate species (see Appendix III). Bees, tree insects and other small arthropods find suitable conditions, in these microhabitats, for their protection and development. Using drilled eucalyptus removed from the area is proposed (using different diameters), achieving simple and economical biodiversity units.

- **Rock piles:** rocky areas can also serve as habitat for many animal groups. Creating or adapting rocky areas so that certain conditions are met (good amount of sunshine for ectotherm animals such as reptiles, hot rocky surfaces for hunter insects spotting their prey, etc.), can convert barren structures in authentic niches, in biodiversity units (see Appendix III).

- **Pond area:** aquatic fauna also has its place in this project. The creation of an artificial pond in the deeper area of the quarry, when mining activities are finished, would generate the emergence of a small aquatic ecosystem that would support life forms such as aquatic insects, small reptiles, amphibians, etc. In addition, this could attract other indirectly related to aquatic life animal groups (birds or mammals that use the area as a drinking place, for example). The construction of a little island in the middle of the bigger pond (a simple pile of rocks) would increase the colonization possibilities by amphibians (see Appendix IV).

- **Clefts on slopes:** the verticality of the slopes and the available machinery makes easier the creation of clefts or cracks on the rock walls of the quarry (see Appendix V). These cavities, by themselves, can serve as shelter for different animal groups, especially for cleft-living bats, like *Myothis blythii*, unique on the area and considered as an endangered species.

- **Nest boxes:** one of the best known and widespread used types of biodiversity units such as this one could not be missed in our project. Besides the beneficial component for passerine birds increasing the number of available niches and protecting them from inclement weather and from predators, nest boxes constitute an important educative resource. They will be built in educational workshops, with the involvement of different age students, using wood coming from previously removed eucalyptus. Some designs are included in the Appendix VI. Nest boxes will be placed in different zones, mainly on trees by the woodland that surrounds the quarry in the North-Northwest, and, when mining activities are finished, on trees and poles located on the inner part (pond area).

- **Bat shelters:** in a similar way to the nest boxes, its construction entails an increment on colonization opportunities and protection for these mammals. Given the proximity of various caves (Cueva de Las Caldas and Cueva de La Lluera) and counting on the presence of natural or artificial cavities on the slopes, these refuges will be focused on forest bat populations. A very simple design is proposed on the Appendix VII, in order to make it also in educational workshops. The same as nest boxes, they will be set up on trees by the forest surrounding the quarry, but not inside it.

FLORA RELATED ACTIONS

REMOVING EXOTIC SPECIES

One of our first actions is to treat the vegetation on the area of the quarry; we will start it while mining activities continue. We will begin locating the exotic species, such as eucalyptus (*Eucalyptus globulus*) and Pampas grass (*Cortaderia selloana*), through transects all around the perimeter of the quarry. After locating the individuals, they will be mechanically removed (controlled logging or uprooting, depending on the difficulty of access). In the case of eucalyptus, this will be carried on using equipment already present on the quarry, so the only related expense will be the salary of the employees doing this task. In the case of Pampas grass, its extraction will be made by volunteer groups with their instructors, in environmental awareness campaigns on exotic species. In the "*Environmental Awareness and Citizen Participation*" section is more detailed. Also, in subsequent volunteer campaigns, annual monitoring of re-growths will be added as a task, that will be done until all the campaigns end.

Special attention is needed on the replacement of the existing vegetal visual barrier (eucalyptus) by another one symmetrically staggered, more integrated with the surrounding vegetation. It will be held in two stages (see Apendix VIII):

- STAGE 1: elimination of half of the current vegetal barrier in an interleaved way (whenever possible), the closest one to the boundary of the quarry; it will be replaced by medium sized shrubs (dogwood, common hawthorn and Mediterranean buckthorn) mixed together with small sized shrubs (dog rose, blackberry bush and common gorse). After 5 years, this vegetation will be large enough to act as visual barrier.

- STAGE 2: five years after the first stage, the other half of eucalyptus will be eliminated (the farther row from the perimeter fence), followed by the subsequent re-vegetation with big sized shrubs/trees (bay laurel, hazel and holly). This will finish the shape of the new "living hedge".

While the new green barrier is growing, the translucent nets attached to the metallic fence on the perimeter will be kept; this translucent material will be removed after the positive assessment of the visual impact mitigation produced by the new shrubs, leaving just the metallic fence. This fence will be replaced by 1 meter high wooden fences in certain parts of the perimeter, serving as viewpoints in the proposed footpath.

REFORESTATION

Reforestation of the basal area with a combination of the following species is proposed: *Quercus robur, Quercus pyrenaica, Fagus sylvatica, Arbutus unedo, Corylus avellana, Taxus baccata, Quercus faginea* and *Castanea sativa* (the last one, despite not being wild in the area, is considered naturalized and contributes to ecosystem diversity and richness). The methodology for choosing the species is based on our field experience in the area of the quarry. The proportions of the species must be the same to those in nearby areas; according to our studies, 10: 2: 5: 2: 2: 1: 3: 4.

Potted trees from 1 m to 1,2 m tall are chosen due to their rooting potential and fast adaptation. The distribution will be random, avoiding following square patterns.

Creating several major areas of shrubby vegetation apart from the complementary shrubby vegetation for the forest area is needed, so we have divided the shrub species chosen in two groups: forest complement species and principal species (see Appendix IX). For the former, we have chosen according to current species in nearby areas (*Crataegus monogyna*, *Arctostaphylos uva-ursi*, *Berberis vulgaris* subsp. *cantabrica*, *Daphne laureola*, *Prunus spinosa* , *Rosa pouzinii* and *Rubus lainzii*); for the latter, we followed the same methodology, proposing species that have been sampled in areas of similar conditions (*Cornus sanguinea*, *Cytisus cantabricus*, *Sambucus nigra*, *Viburnum lantana* and *Calluna vulgaris*).

For the pond area we consider *Salix atrocinerea*, *Alnus glutinosa* and *Fraxinus excelsior* as the most appropriate; in terms of aquatic species, *Ceratophyllum demersum* has a big interest due to its small range in the region of Asturias and its habitat sensitivity; *Utricularia australis* and *Myriophyllum alterniflorum* are also species of interest due to their vulnerable cataloging. Another species chosen for this area is *Equisetum arvense*.

BASAL ZONE HYDROSEEDING

For hydroseeding in the basal zone, we propose the main use of grasses (*Bromus erectus*, *Briza media* and *Dactylis glomerata)* and legumes (*Vicia cracca*, *Anthyllis vulneraria, Lathyrus pratensis, Lotus corniculatus, Trifolium* spp. and *Medicago spp)*; moreover, we recommend some additional species like *Angelica archangelica, Crepis vesicaria, Helleborus viridis* and *Stellaria holostea*.

Seed use is recommended at a rate of 350 kg/ha of which 80% will be grasses and legumes.

We consider that the sporadic use of cows and horses can increase the number of plant species in a short period of time; it could also enrich the soil, increasing the aesthetic and socio-economic value of the area.

SLOPES RE-VEGETATION

Two actions are proposed:

- The first one aims to stabilize the vegetation on the terraces (ledges); for this reason, the use of organic substrate is proposed, due to low soil availability, in a continuous layer of 30 cm; hydroseeding will be done here with target species as detailed below.

  Lolium rigidum has been chosen as rapid growth starter. It is recommended to distribute the rest of species as follows: *Bromus erectus* and *Dactylis glomerata (*Gramineae*), Anthillis vulnerary* and *Lotus corniculatus (*Leguminosae*), Arenaria grandiflora (*Caryophyllaceae*), Euphorbia flavicoma (*Euphorbiaceae*), Tussilago farfara, Erigeron karvinskianus* and *Senecio mikanioides (*Asteraceae*), Trollius europaeus (*Ranunculaceae*), Cymbalaria muralis (*Plantaginaceae*),* and *Hedera helix (*Araliaceae).

  Total dose of seeds: 250 kg/ha. It is recommended that the proportion of species (in number of seeds) is the following:

  - 50% soil-fixing species (true grasses).
  - 30% nitrogen-fixing species (legumes).
  - 20% rest.

- The second action proposed in slopes is the realization of gaps, cracks or holes in the vertical slope areas with a varied angle of between 45 and 90 degrees, in which shrubs and herbaceous species with resistance to slope conditions will be planted. These holes will be filled with appropriate soil for the species planted. *Umbilicus rupestris* is the main chosen species, along with *Hedera helix* and *Cymbalaria muralis*; several species of *Juniperus* spp. are also selected as slope shrubs.

ENVIRONMENTAL FOOTPATH CONDITIONING

One of the pillars of our social-educational project in La Medina is a tour around the quarry that, once the mining activities are completed, will include an additional route through the interior area of what was once the limestone quarry we know today. This is the reason why we have proposed two footpaths, which share most of the route but, when you get to a certain point, is divided in:

- ***Circular route*** (see Appendix X): is a footpath where the arrival is at the same point as the origin, which will be around the quarry facilities. The information regarding this route is the following one, in approximate values:

Distance	2500 metres
Estimated duration	2 hours
Number of information boards	5
Elevation gain (ascent)	180 metres
Elevation gain (descent)	180 metres
Maximum gradient	33%
Medium gradient	14%

We propose to begin the implementation of this route immediately after starting the replacement of the current vegetal visual barrier, composed of eucalyptus (after the first phase), leaving spaces without vegetation to have panoramic views of the quarry. Wooden fences (1 meter high) will be placed in these open spaces; these railings will be made of wood from the removed eucalyptus trees. In areas of the path far from the quarry, the placement of those fences would not be necessary to prevent falls. On the other hand, they will be necessary in some sections of the path coming in parallel along the paved trail that runs along the southern boundary of the quarry. In the northern part of the route, we will prepare the existing public path through trimming and soil stabilization, placing railings in areas of steeper slopes.

Five information boards will be placed along the route (see the example on the Appendix XII), with variable content based on location possibilities. Here are our proposals:

1. **The limestone**: board placed at the beginning of the route explaining the process of extracting, processing and utilization of limestone.
2. **The quarry and its people**: placed in the northern part of the route, at the level of La Ventina quarry, with photographs of its previous state, during and after mining activities. With references to the nearby population and the employment attracted to the municipality.
3. **La Medina**: located in one of the highest parts of the route, with good views of the quarry. Similar to the previous board, but with references to flora and fauna (given the proximity of chestnut forest).
4. **The slopes: living walls**: located in the far southwest point of the quarry, at the end of the "V" which will remain at the end of the activities of that sector. Content based on the stratigraphy of minerals (if any), to pasture (and livestock) and heath when looking to the south and around, and the potential offered by slopes for cliff and cleft-living flora and fauna.
5. **Let's have a look to the pond**: small board located at the junction of the two proposed routes that will give to the visitor the option of finishing the course in parallel to the paved trail, walking by the south of La Ventina, or making a visit to the pond system that will remain at the end of the activities. It could contain some references to biodiversity units located in the surrounding (bee hotels or rock piles).

All the information boards will have an educational content, explained through images and texts presented in the environmental interpretation activities of "*La Medina in your classroom*" program. In addition to text

and images, every board will be linked to virtual content through QR codes (or equivalent technology), increasing the information available. The last two boards would be placed only at the end of the activities in the quarry.

- ***Ponds route*** (see Appendix XI): is an extension of the previous route through the pond area that will be inside the area of the quarry when it has been abandoned and, therefore, this route may only be conceived once mining works are finished. Like in the circular route, soil where the route is going over will be stabilized and railings will be placed on the sections of the footpath where needed (for slope or high risk of falls). Some data regarding this proposed extension of the route, in approximated values:

Distance	2800 metres
Estimated duration	2 hours 30 minutes
Number of information boards	6
Elevation gain (ascent)	230 metres
Elevation gain (descent)	230 metres
Maximum gradient	42%
Medium gradient	15%

In addition to the previous 5 information boards included in the circular route, there will be an extra board in the part of this route going across the ponds:

6. **A pond in the middle of the quarry**: explanatory board on the process of creating the ponds and the faunal diversity attracted: source of freshwater, amphibian breeding area, etc.

NOTE: slopes gradient will be reduced after the stabilization and softening of the ground using the machinery of the quarry, so that the values presented on the previous charts must be taken into account only as a provisional data.

ENVIRONMENTAL EDUCATION PROGRAM

We think it's very important that people in the area is well informed about what is happening in and around the quarry, which processes are carried out in the facilities and how this influences the local economy and the natural environment. So we have designed several activities for both, children and teenagers, and all ages adults. We will have the cooperation of schools and organizations dedicated to environmental education, as CEAM Asturias. These activities are described below:

Environmental Education for Schools

"La Medina in your classroom": program to be carried out in primary and secondary regional schools for one (or two) weeks a year, either one hour of a single activity or two and a half hours doing the three proposals.

1. **Meet La Medina biodiversity:** why is biodiversity important in general and in particular in an environment like our quarry. Activity adapted for primary and secondary education children, lasting 60 minutes, in regional schools.
2. **The food chain in La Medina:** activity where the ecological interactions that occur in ecosystems belonging to La Medina are carried out. Destined at primary and preschool education.
3. **Do you know how a quarry works?** Activity adapted to middle and high education on the operation of a quarry, the end use of obtained products, geology of the environment and sustainable future.

"A day exploring La Medina": program to be performed in the vicinity of La Medina, a full-day lasting, intended for secondary, high school and higher education students.

Morning activity:

Walking the quarry: interpretative trail about the wildlife that compose La Medina environment, where students discover how to interpret faunal traces and the geological history of this place. The contents will be adapted to middle and high school students. History of the quarry and its recovery plan will be taught to high school students. The route (during mining works: circular route; see Appendix XI) is about 2,5 km away length, low difficulty, with stops marked with information boards. This route has a total duration of about three hours. Students will be provided with materials such as binoculars and guides to reinforce the content. At the end of the route, a dynamic assessment for students will be held.

Safety is most important to us, therefore, the maximum number of students per group will never be greater than 60, and a monitor will be hired for every 20 students.

Afternoon activities:

1. **Building nest boxes in La Medina**: making nest boxes for passerine birds and bats. Removed eucalyptus wood will be reused for this purpose.
2. **Learn how to restore:** dynamic simulation workshop about restoration of gravel pits and quarries will be carried out using real examples in the classroom. Images of degraded areas will be shown to the students, so they have to provide solutions for its restoration.
3. **Discover the secrets of La Medina**: interpretation of the site geological history, discovery of minerals and rocks that form the environment, and awareness of the importance of their extraction and their final destination. Students will manipulate different minerals and materials from the mining area and its surroundings for this purpose.

Each one of these afternoon activities will last one hour and a half approximately.

Environmental Awareness and Citizen Participation:

Proposals for the general population (local residents, ecotourist visiting Asturias, etc.), in which environmental awareness and involvement of citizens in the natural environment conservation is the main purpose.

- **Ecotourism:** on certain dates, as may be the World Biodiversity Day (22nd May), we propose the realization of the interpretive trail (previously explained in "Walking the quarry") having as second activity the tasting of typical products of the region. These activities, will take a total of about 4 hours (in the morning or afternoon).
- **Volunteers in La Medina:** with the help from organizations like CEAM Asturias, we will arrange environmental volunteer days throughout the year, coinciding with certain dates such as World Biodiversity Day, Environment Day, etc. In those days, about 50 volunteers will carry out activities of biodiversity conservation and environmental cleanliness, for about 3-4 hours a day.

    1. **Removal of exotic species** (such as *Cortaderia selloana)***:** specimens less than 1 meter high will be uprooted manually while the larger ones will be removed using tools to ensure effective elimination of roots. Thus we try to facilitate their control. Part of the resulting waste will be reused for the construction of bee hotels by volunteers, and the excess will be burned authoritatively and subsequently transferred to a landfill.

    2. **Plantation of native species and maintenance of existing forests:** "harmony day" coinciding with World Tree Day (28th June), in which residents of nearby towns are invited to planting a tree per family. Both children and adults will fill the surroundings of the quarry with native species, such as chestnuts (with a planting pattern of 3,5 m. X 3,5 m). The greater the mass of native species in the area, the easier and more effective the control of invasive species. The conditions under which each species grows better will be considered.

    3. **Building and placing nest boxes, bee hotels and shelters for bats:** volunteers will build, as children did before (see "Afternoon activities" in "Environmental Education for Schools"), nest boxes, bee hotels and bat shelters that will be placed by them in some points of the quarry. Eucalyptus wood will be used for making nest boxes and bat shelters; Pampas grass stalks will be used for the Bee Hotels.

    In order to present these activities to the people, they will be promoted through social networks, advertorials in local digital newspapers and radio slots. Furthermore, in order to motivate participants, whenever possible, the work shall be accompanied by, for example, delivery of merchandising (t-shirts, stickers, etc).

    As was the case with school groups, the most important thing for us is the safety of the participants, so that the above-described proposals won´t be carried out by larger than 60 people groups, and they will include a monitor for every 20 participants.

All these proposals could be carried out immediately, while the mining works are ongoing in the quarry. The "*Walking La Medina*" activity will take place once the surrounding path has been conditioned.

The budget assigned for these educative actions and all the other planned actions is detailed on the Appendix XII.

DISCUSSION

Throughout the foregoing project, the more suitable solutions for our final objectives have been detailed. In the search for these goals, we consider that our proposals are full of **advantages** such as the following:

- **Immediacy**: much of the work planned can be done from this moment.
- **Compatibility with mining works**: related to the above, there are lots of proposed actions that can be carried out while the company's mining works continue.
- **Realism**: all the proposed actions are feasible plans considering the material means currently available and, in addition, these plans have been adjusted from the economic point of view. No unrealizable task or goal is planned, and no excessive budget is considered.
- **Multidisciplinarity**: is one of the bases of this project. We have considered multiple targets (increasing of the faunal and floristic diversity, environmental education of the population, etc.) that, in the end, make the proposal more complete and the work more productive.

Obviously, we have tried to design a plan with the fewest possible **cons**; within these, perhaps we could mention the **prolongation in time** of some proposals (because they would be linked to the end of the mining activities) or **the dependence on the population response** in those aspects related to the environmental education, because we cannot be sure that the reception of the idea by the population will be adequate.

Anyway, it is considered that the pros far outweigh the cons, and our proposal has a very positive impact on the following aspects:

1. Biodiversity: with the proposed measures in the project, the existing biodiversity (both faunal and floral) is preserved and even encouraged through different plans that optimize the environmental conditions for keeping the life.
2. Society: as this plan includes a series of educational measures in the environmental aspect, and as it involves the population in many projects and activities, we believe that this project can have a great positive impact on the society, raising awareness about the possibility of an environmentally friendly exploitation and about the importance of respecting the environment on life.
3. Company: the awareness about the compatibility between exploitation and environmental respect, and about the effort made by the company for maintaining biodiversity in the operating area, will lead to an improvement of the corporate image of the company. Furthermore, as indicated above, budget will be tight, without supposing an unaffordable economic effort for the company.

FINAL CONCLUSIONS

Nowadays, we know that, the more diverse an ecosystem is, the easier its conservation. A diverse ecosystem is better suited to changes and is more likely to recover from impacts and last in time. Furthermore, industrial and technological development of our community shouldn´t be incompatible with the conservation of our natural heritage. So, we must join forces among all (citizens, companies, institutions…) in order to achieve sustainable development, with compatibility between progress and nature conservation.

The previously proposed plans not only assure this compatibility, but also its maintenance over the time and how deeply is touched the population by this idea. The project viability, its clarity of ideas and its potential benefits (at all levels) with a very simple investment, make worthy this effort to carry it out.

APPENDICES

APPENDIX I: LOCATION MAP

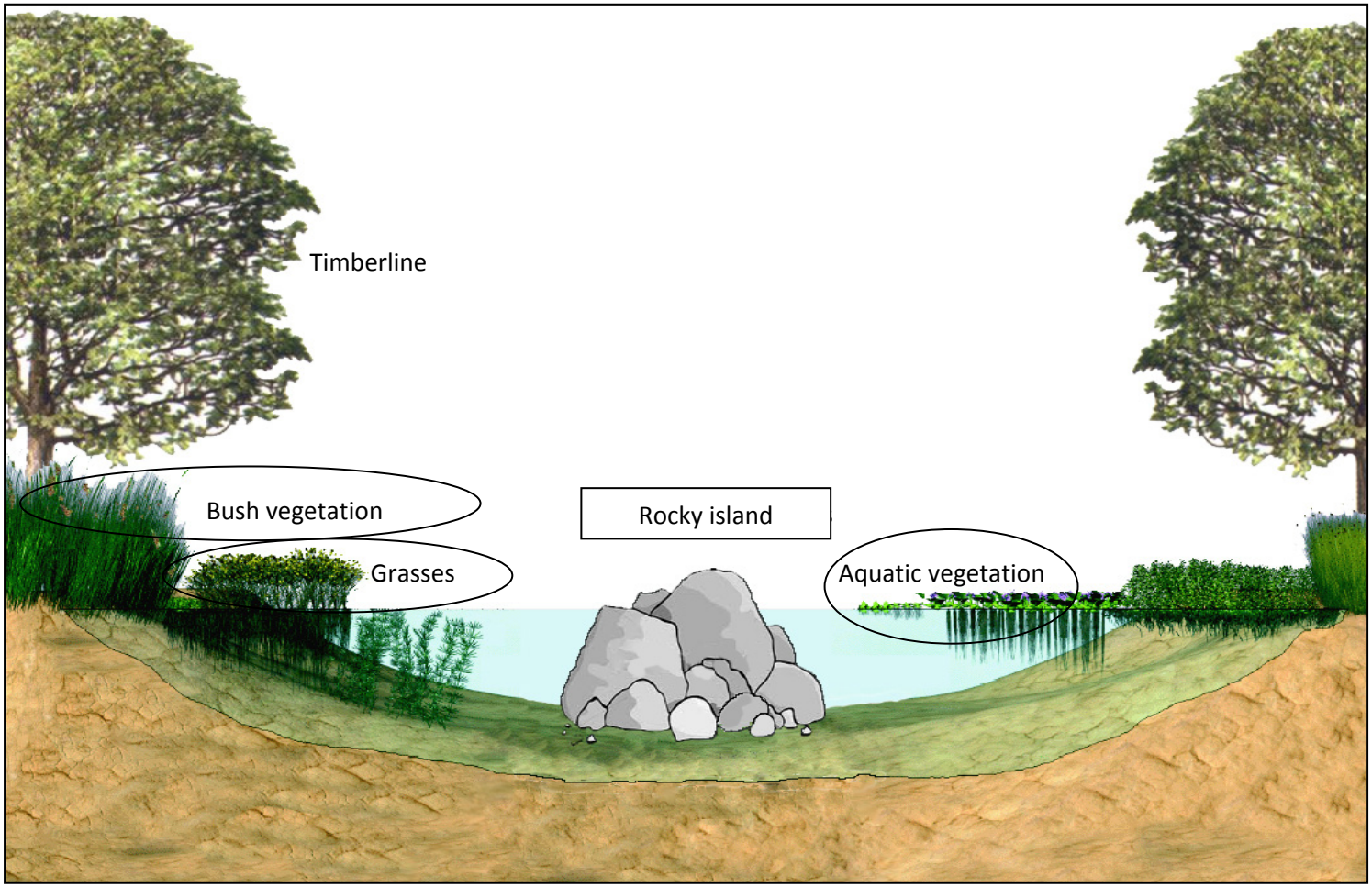
APPENDIX II: EXOTIC SPECIES

Cortaderia selloana

Eucalyptus globulus

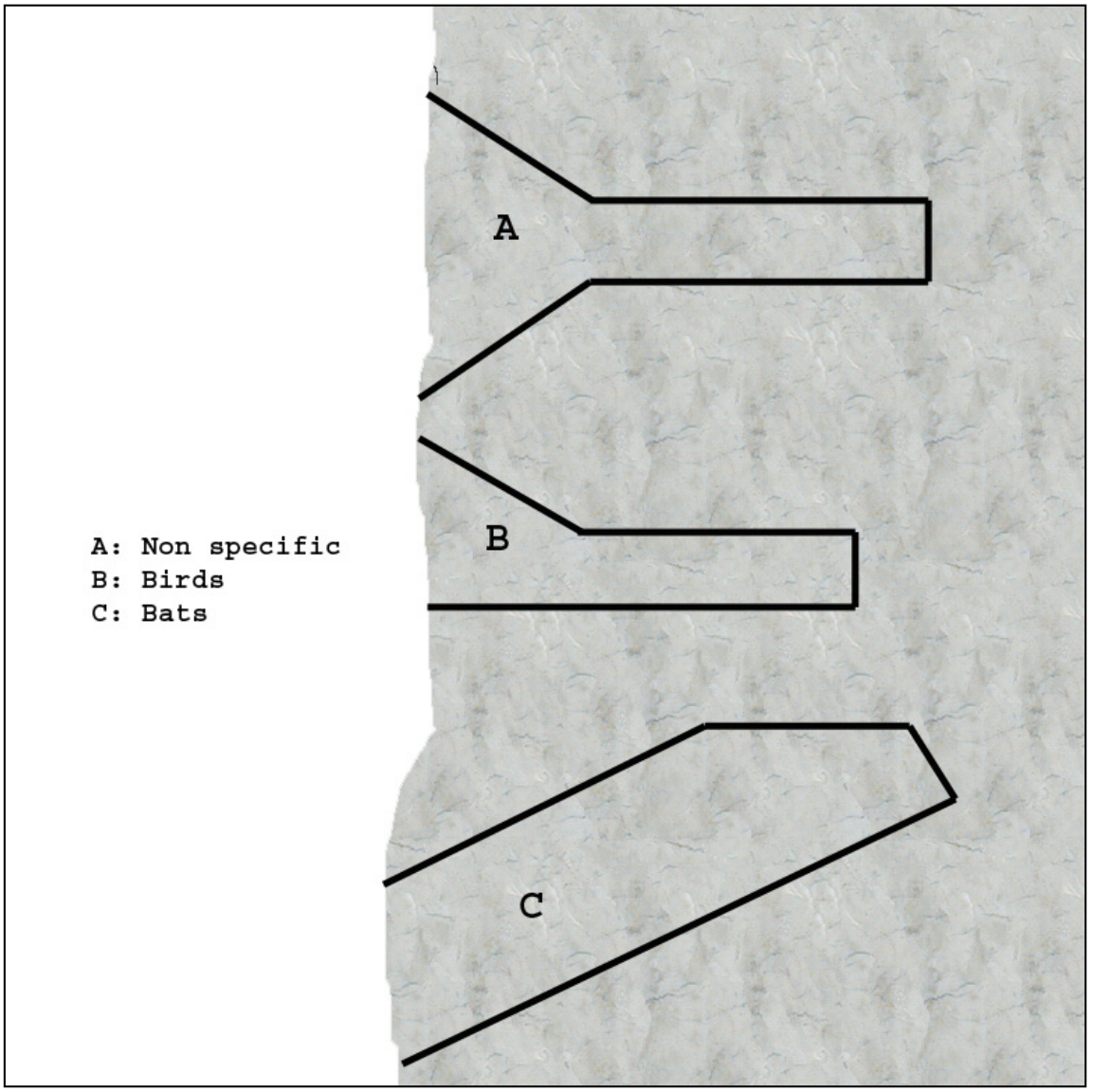
APPENDIX III: BIODIVERSITY UNITS

APPENDIX IV: POND AREA OUTLINE

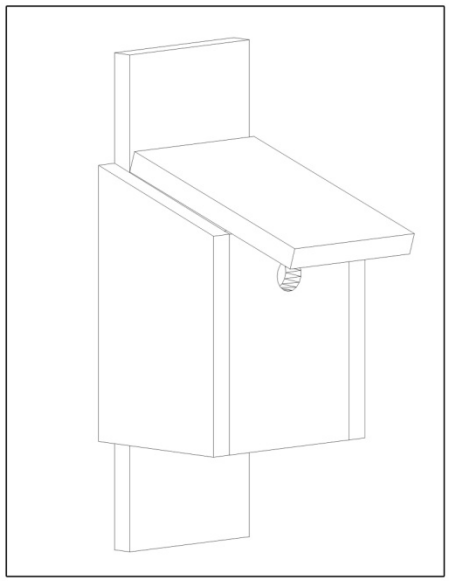


APPENDIX V: CLEFTS ON SLOPES

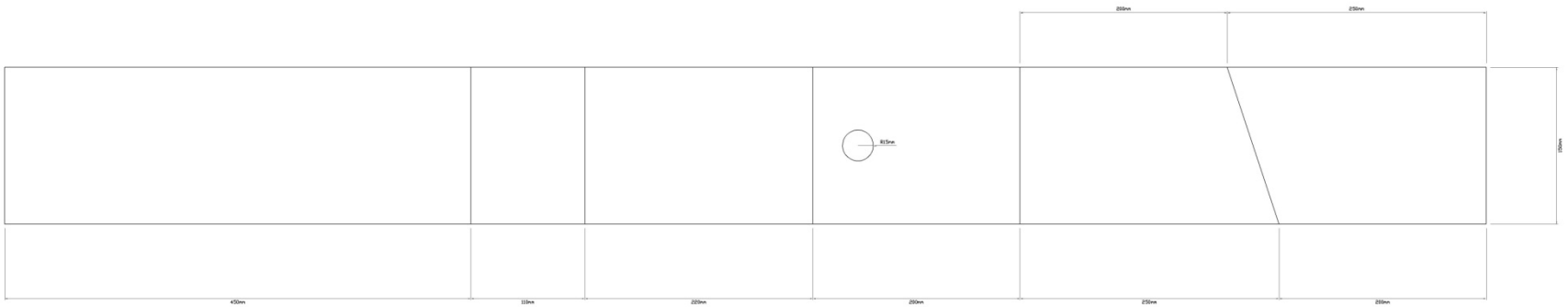
Myotis blythii (Tomes, 1857)



APPENDIX VI: NEST BOXES DESIGNS



Nest box for passerines	
Type of nest box	Mailbox or balcony
Material	Non-sand eucalyptus wood
Wood thickness	20 mm
Aperture system	Upper hinge
Colocation height	2-5 metres



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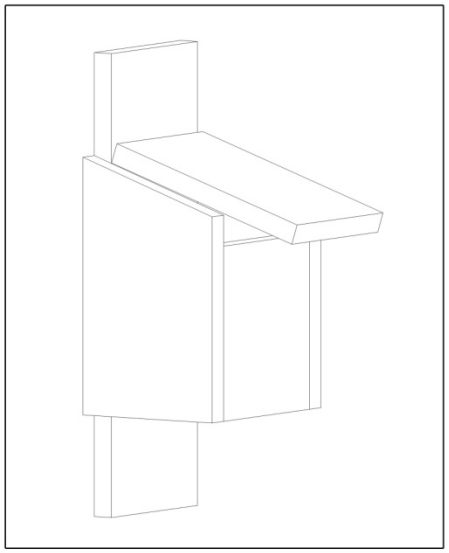
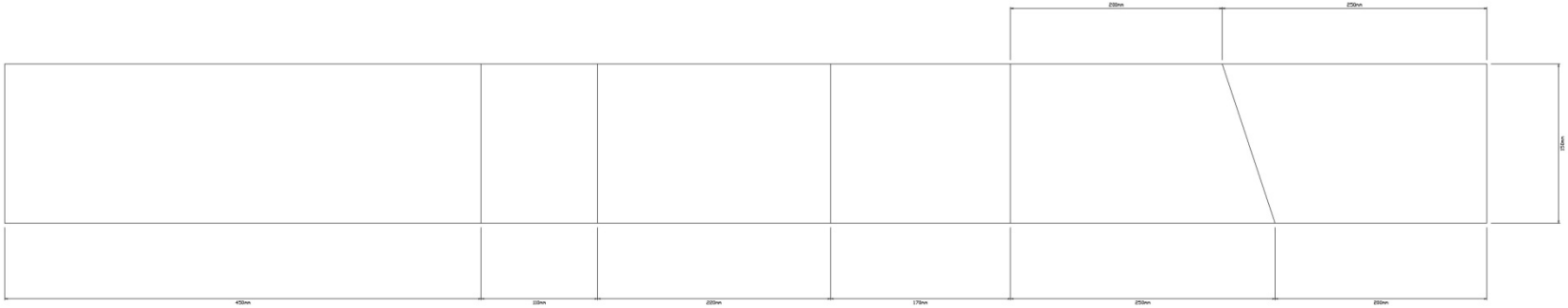
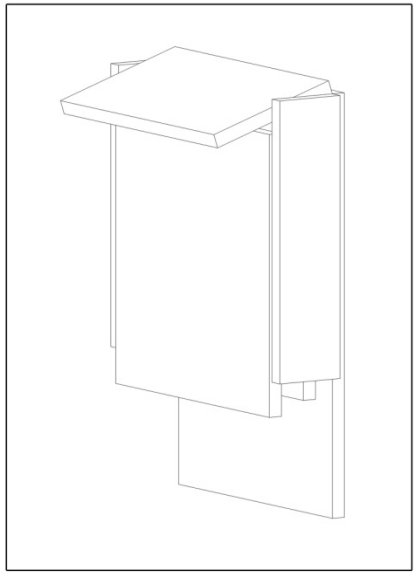


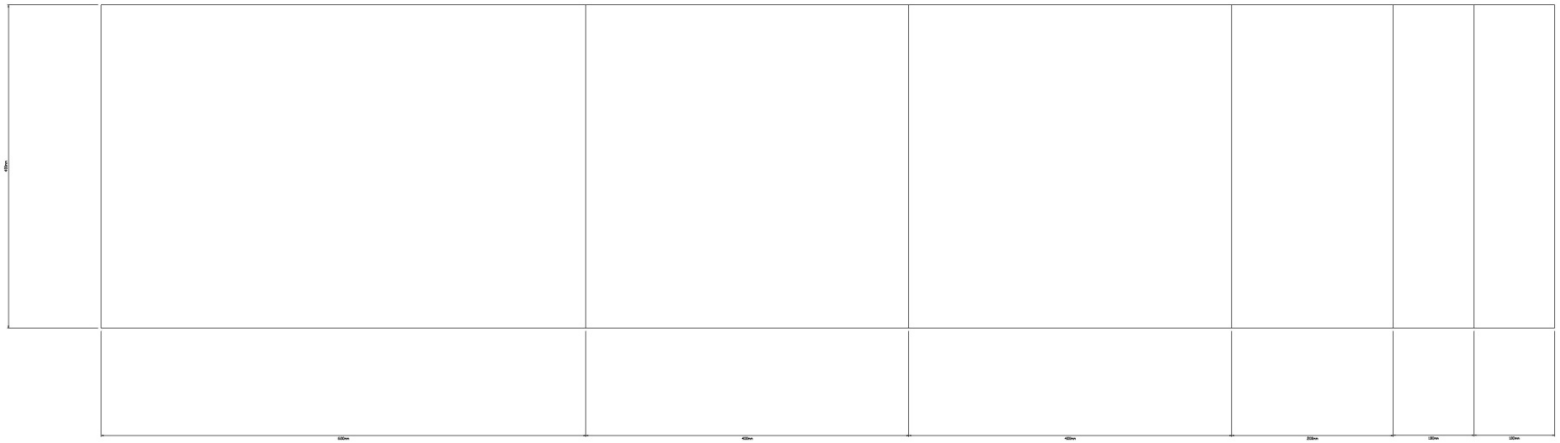
Nest box for wagtails	
Type of nest box	Opened front
Material	Non-sand eucalyptus wood
Wood thickness	20 mm
Aperture system	Upper hinge
Colocation height	2-3 metres



APPENDIX VII: BAT SHELTER DESIGN

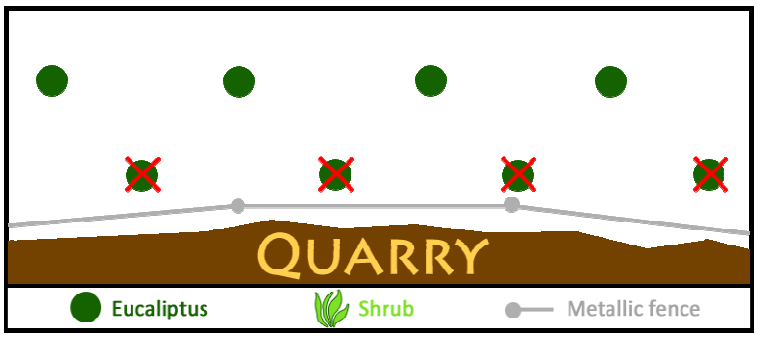
Bat shelter	
Type of nest box	Divided interior Inferior aperture
Material	Non-sand eucalyptus wood
Wood thickness	20 mm
Aperture system	No
Colocation height	4-6 metres



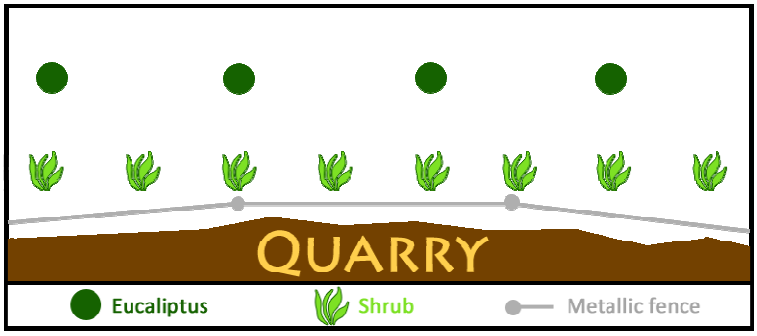


APPENDIX VIII: EUCALYPTUS BARRIER REPLACEMENT

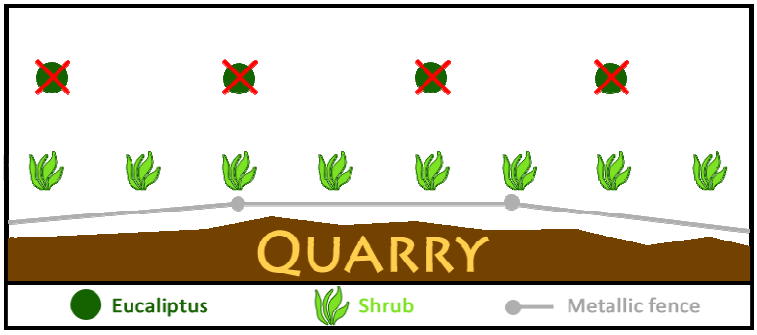
STAGE 1: *eradication of the row of eucalyptus closer to the perimeter fence.*



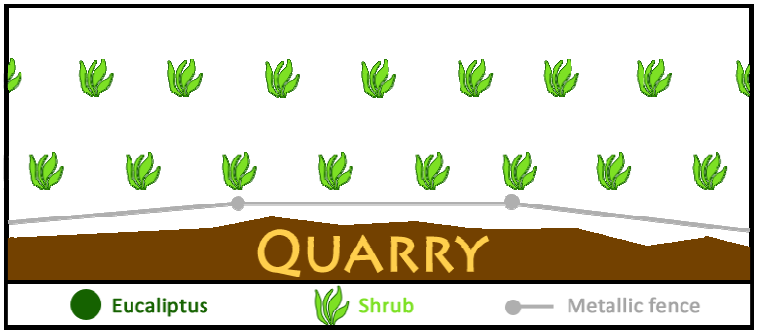
Sapling planting: common dogwood (*Cornus sanguinea*), common hawthorn (*Crataegus monogyna*) and Mediterranean buckthorn (*Rhamnus alaternus*), mixed together with small sized shrubs like dog rose (*Rosa canina*), blackberry bush (*Rubus fruticosus*) and common gorse (*Ulex europaeus*).



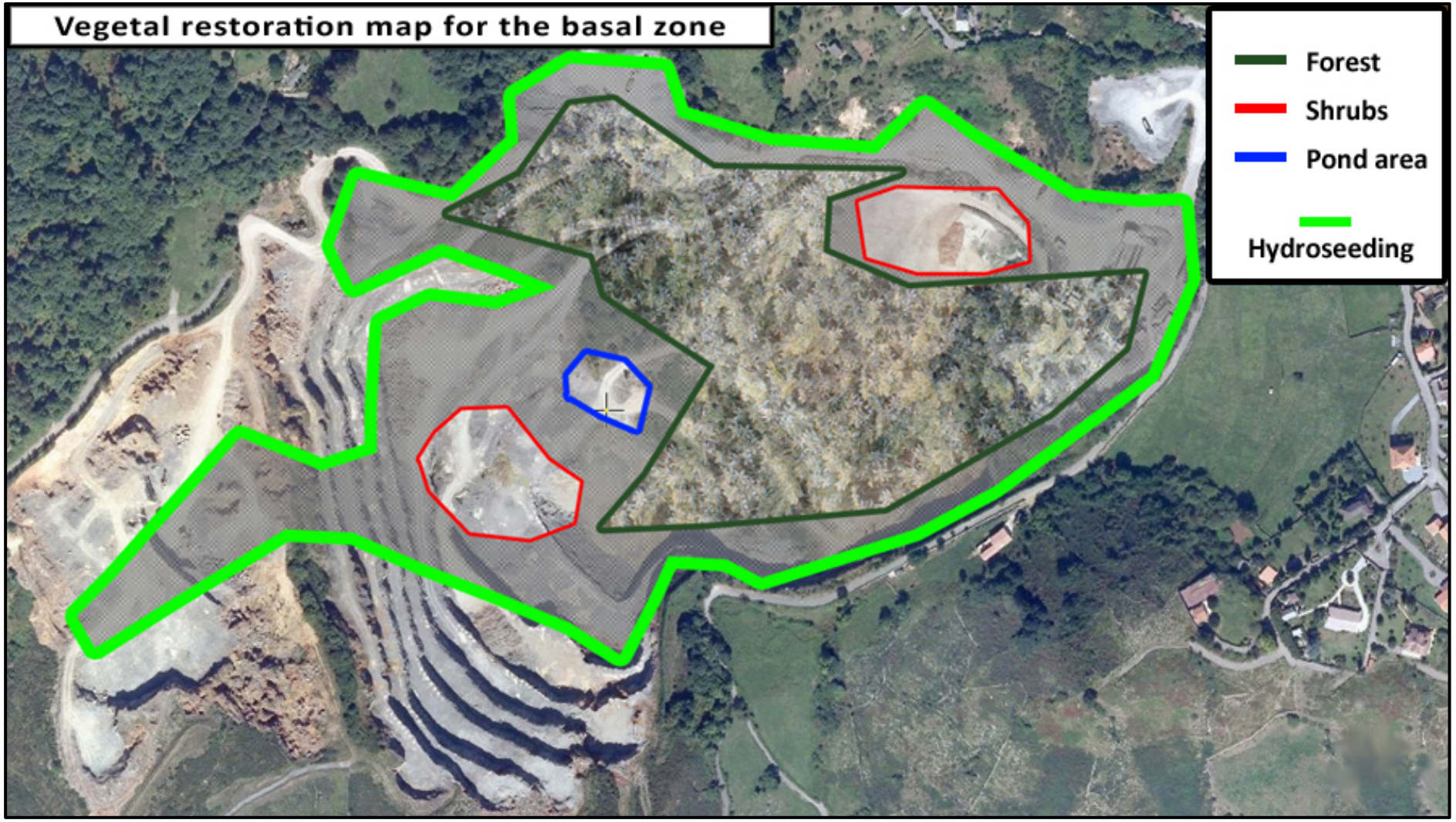
STAGE 2: *five years after the first stage; elimination of the row of eucalyptus farther from the perimeter fence*.



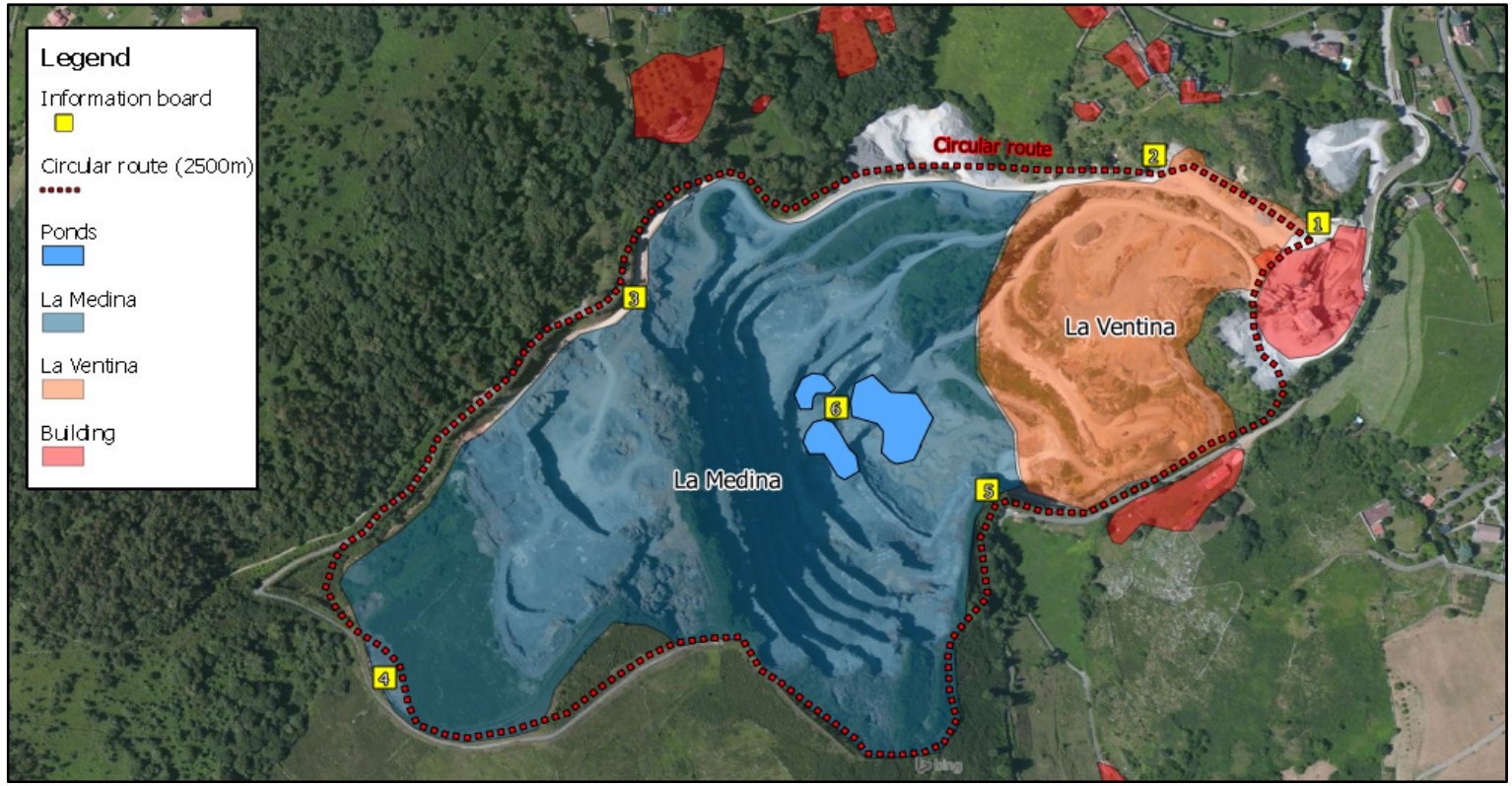
Re-vegetation with bay laurel (*Laurus nobilis*), common hazel (*Corylus avellana*) and holly (*Ilex aquifolium*).

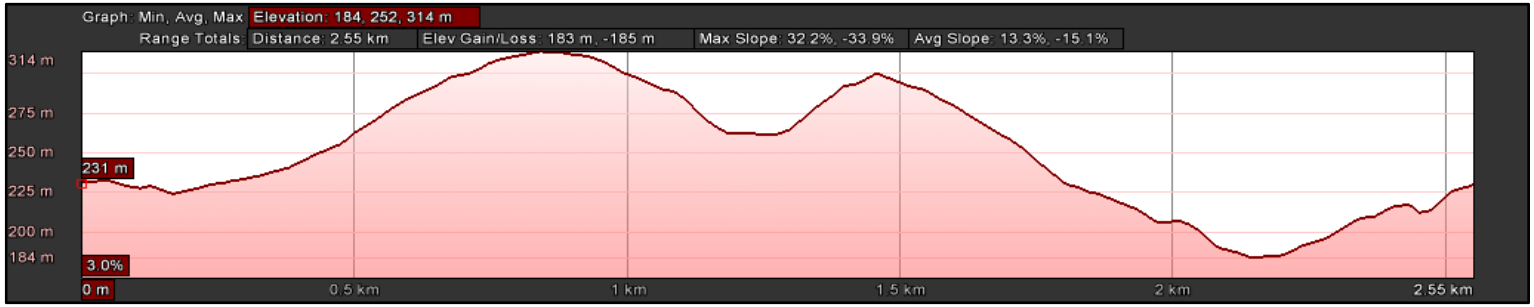


APPENDIX IX: VEGETAL RESTORATION MAP

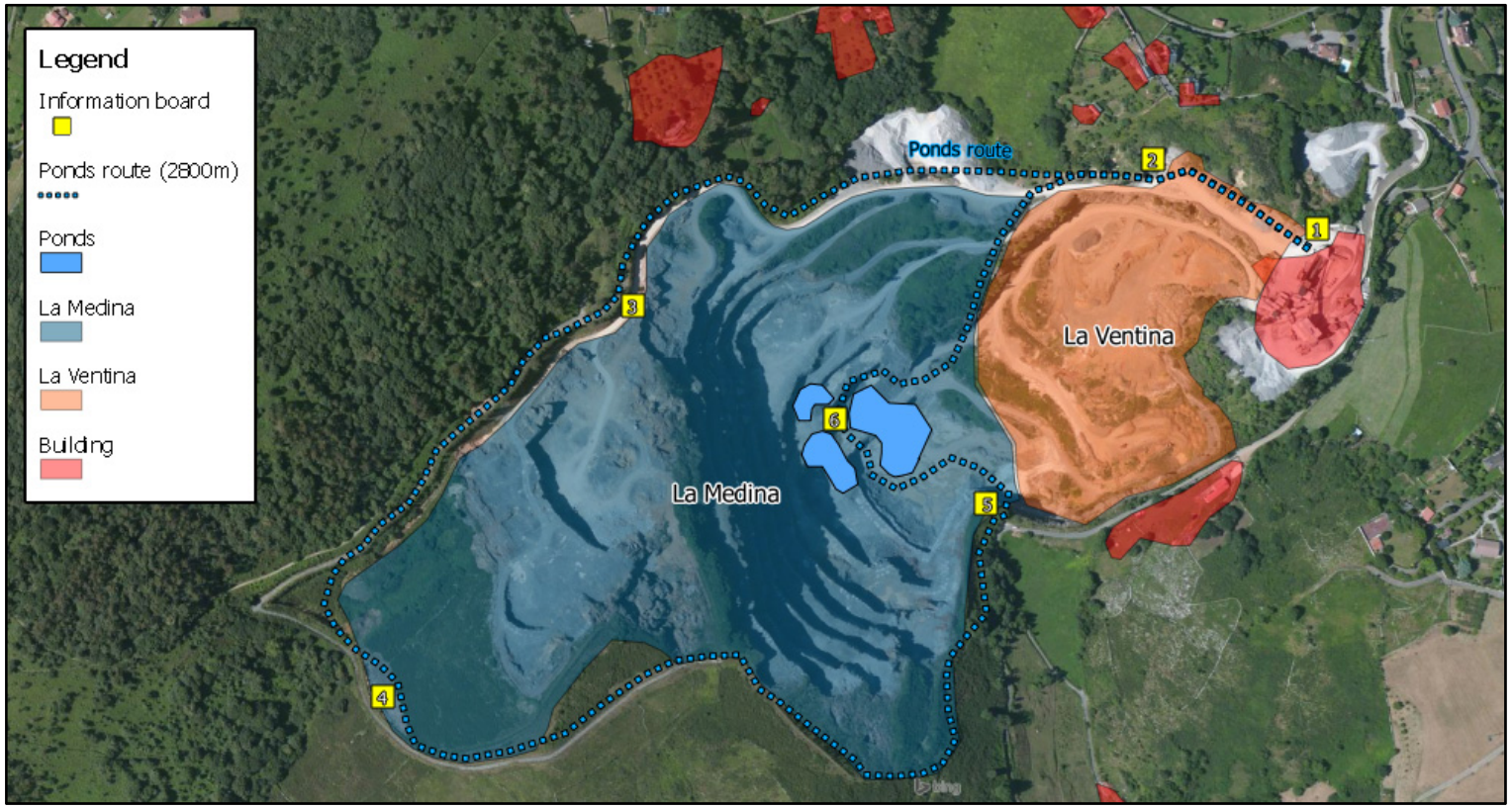


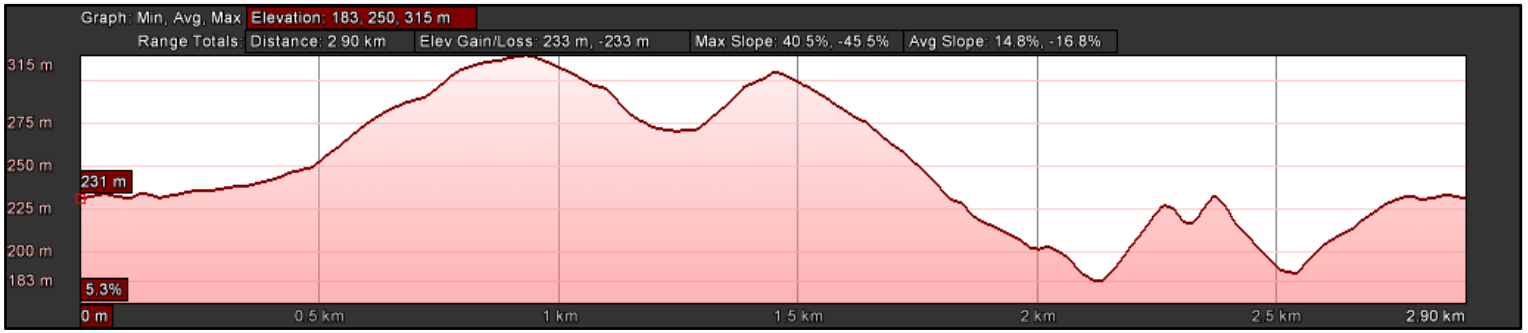
APPENDIX X: ENVIRONMENTAL FOOTPATH MAPS – **CIRCULAR ROUTE:**





APPENDIX XI: ENVIRONMENTAL FOOTPATH MAPS – **PONDS ROUTE:**





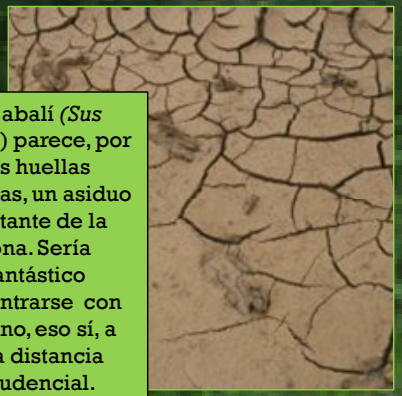
APPENDIX XII: INFORMATION BOARD MODEL

Punto de información 3:

LA MEDINA

¡Hola amigos! ¿Cansados después del primer tramo de ruta? Buenas noticias: es el momento idóneo para descansar un rato. Nos encontramos en el punto más alto de la senda, desde el cual podemos divisar toda la cantera a vista de pájaro; así, al mismo tiempo que observamos el trabajo de nuestros compañeros, podemos echar un vistazo a la abundante y diversa fauna y flora del entorno. En este panel te ofrecemos una breve reseña de algunas de las especies que podrás encontrar en la zona. Estate atento…¿serás capaz de verlas con tus propios ojos?

El murciélago ratonero mediano, *Myotis blythii*, es uno de los grandes protagonistas de la fauna local. Esto se debe a que en la vecina cueva de Las Caldas se encuentra su única zona de cría en toda la región.



El jabalí *(Sus scrofa*) parece, por las huellas dejadas, un asiduo visitante de la zona. Sería fantástico encontrarse con alguno, eso sí, a una distancia prudencial.

El bosque de castaño (*Castanea sativa*), tan típico en estas latitudes, también está presente en nuestra senda. Date la vuelta y lo comprobarás.

No todas las especies de la zona son autóctonas. En estos terrenos pueden apreciarse plantas exóticas e invasoras, como la *Cortaderia selloana* (foto) o el eucalipto blanco (*Eucalyptus globulus*), cuya gestión es importante para preservar las formas locales .

APPENDIX XIII: BUDGET CHART

CONCEPT	NUMBER	AMOUNT	TOTAL/h	HOURS	TOTAL
BIODIVERSITY UNITS					
Digger	1	36.96€	36,96€	2	73,92€
Hardware goods for bee hotels	-	150€	-	-	150€
Workforce (workman)	5	10.82	54.1 €/h.	5	270.5€
Workforce (foreman)	1	15,03	15.03€/h.	5	75,15€
WORKSHOP ACTIVITIES					
Talks instructor	2	15€	15€/h.	-	1300€
Workshop materials	VARIABLE	300€	-	-	300€
Publicity	-	1500€	-	-	1500€
HYDROSEEDING AND REFORESTATION [1]					
Hydroseeding	14.000 m^2	1,23 €/m^2	-	-	17.220 €
Manual seeding of field shrubs and bulbous plants	1.000 m^2	6,54 €/ m^2	-	-	6.000 €
Forest trees supply and planting	2.000 Units	16,66 €/Unit	-	-	33.200 €
Forest trees from lagoon area supply and planting	30 Units	15,68 €/Unit	-	-	470,40 €
Atlantic shrub supply and planting	3.000 Units	5,38 €/Unit	-	-	16.140 €
INFORMATION BOARDS					
Informative wooden board completely installed	5 Units	212,48€/Unit	-	-	1.062,40 €
2x2 m. wooden panel, roof, water protection and quality materials	1 Unit	1.168,60 €/Unit	-	-	1.168,60 €
SLOPES [1]					
Supply and collocation of steel mesh (B-500-T)	10.000 m^2	2,73 €/m^2	-	-	27.300 €
Mulching	10.000 m^2	2,67 €/m^2	-	-	26.700 €
Grass hydroseeding	10.000 m^2	1,23 €/m^2	-	-	12.300 €
CONTROL					
Monthly control of the forestall recuperation operations	192 horas	-	23,22 €/h.	-	4.458,24 €
TOTAL					**149.689,21€**

[1] The workforce expenses for these actions in included on the contracted services.

APPENDIX XIV: DEVELOPMENT GRAPHIC OF THE PROJECT OVER THE TIME