THE QUARRY LIFE AWARD

HEIDELBERGCEMENT

Final Project Report (to be submitted by 30th September 2016)

1. Contestant profile

▪ Contestant name:	**Sandra Pschonny and Sabrina Behrendt**
▪ Contestant occupation:	Student
▪ University / Organisation	TU München
▪ E-mail:	
▪ Phone (incl. country code):	
▪ Number of people in your team:	**2**

2. Project overview

Title:	Great impact with little effort – optimization of reptile habitats by using existing materials
Contest:	Germany and International
Quarry name:	Burglengenfeld
Prize category: (select all appropriate)	☐ Education and Raising Awareness ☒ Habitat and Species Research ☒ Biodiversity Management ☒Student Project ☐ Beyond Quarry Borders

Abstract (max 1 page)

Reptiles are increasingly suffering from habitat loss, intensification of agriculture and disturbance caused by human activities, and the remaining habitats are often fragmented (HUTTER & FAUST 1994, BLAB & VOGEL 1996). Quarries may constitute alternative habitats due to their high diversity of suitable structures (BLAB & VOGEL 1996, ASSMANN 1998). Quarries are characterized by small-scale heterogeneity with wet and dry site conditions, different slopes, exposition and substrates (BEIßWENGER et al. 2002). Especially reptiles benefit from this habitat mosaic within quarries. Indeed, grass snake, viviparous lizard, slowworm and the smooth snake, the latter protected under the Habitats Directive, have already been documented in various extracting sites (GILCHER 1995, GILCHER & BRUNS 1999). Nevertheless, the full potential of quarries as refuge for reptiles and measures for active improvements need more attention, since some aspects, as for example the dynamics of scree slopes, are neglected in current conservation management of quarries. The prime objective of quarry management is to ensure a smooth and efficient production process throughout the site. Deadwood, rubble or woody encroachment are potentially impeding this process and thus are seen as disruptive factors. Thus, maintenance cuts of trees and shrubs are carried out, and scree slopes are removed. This causes extra work and disposal costs.

In our study site of the Quarry Life Award 2016, the Burglengenfeld Quarry near Regensburg, organic waste is stored on a scree slope until it is processed and removed. The main aim of this 'waste-oriented' approach is to remove all materials that could be disruptive for the daily routine of the quarry, while in fact, nature could benefit from a more intelligent disposal process. Deadwood can be arranged to benefit certain species, and compost heaps have great ecological potential, because they can serve as hiding or reproduction places for various animals (ASSMANN 1998, NABU LEIPZIG 2013, SOZIALER GARTEN & SENSE.LAB 2014, LFU KULMBACH 2016). Reptiles use those structures for egg deposition and hibernation, because of the elevated temperatures inside, and protection against predators (HUTTER & FAUST 1994, BLAB & VOGEL 1996).

The aim of our contribution to the Quarry Life Award 2016 is to evolve an overall concept to improve biodiversity in quarries by using innovative methods of dealing with organic waste. We selected four reptile species as target species because quarries offer them important alternative habitat and they often use organic waste. Our main methods are:

1. Relocation of the compost heap based on a new "rotational compost concept" to avoid disturbances in the hibernating period and oviposition phase, and ensuring more diverse temperatures.
2. Optimization of dead wood inventory.
3. Removal of vegetation on the scree slopes to improve places for sun-basking of reptiles.

All methods were integrated in the ongoing quarry operation, and are used to optimize reptile habitats instead of creating new installations with introduced material. The waste concept of the quarry would then become 'use-oriented' leading to higher benefits for nature, whitout creating much additional costs. As organic waste is frequently created in any quarry our concept can be easily adapted worldwide with little effort.

2. Project area

2.1 Quarry Burglengenfeld

The quarry Burglengenfeld is located near Schwandorf (Bavaria), approximately 25 km north of Regensburg (Annex, Fig. 1), at 400 m above sea level (HW: 54 53250-54 54750, RW: 45 01750-45 02750).

2.2 Target species

Grass snake, smooth snake, viviparous lizard and slowworm were selected as target reptiles for our project because they frequently use compost heaps. For an overview of their main characteristics and habitat requirements see Table 1 (Annex). All four species have already been documented in the Quarry Burglengenfeld (RADEMACHER 2001). For stable populations of these species some exchange with near-by populations is essential, and thus the surrounding of the quarry was investigated for suitable habitats of the target species (Annex, Fig. 1). We considered a radius of 3–4 km, because reptile movements are possible over this distance (ROTH 2011). Due to the Atlas of Reptiles (DGHT e.V. 2014) all target species are documented in the close proximity of the quarry.

2.3 Description of the project area

The project area (Fig. 1) is located in the oldest part of the quarry where the last extraction happened about 50 years ago. Due to frost shattering, rocks drop off the southeast-exposed cliff resulting in screes with an average height of 8 m (Fig. 1, grey). These scree slopes can offer places for sun-basking of reptiles, and the smooth snake was already recorded in 2001 (RADEMACHER 2001). Unfortunately, in 2016 it was highly shaded by increasing vegetation. Furthermore the scree was covered by compost at a length of 50 m at its northeast part before onset of the project (Fig. 1, brown). It was temporary stored at this site and within a zyklus of 6 years removed. The compost was overgrown by perennials and woody plants. As a result of the adjacent storage place for fly ash, vehicles disturbed the immediate environment of the compost. The dirt road at the bottom of the cliff (Fig. 1, yellow) was rarely used, and thus no real barrier to the adjacent wooded areas including small piles of deadwood, which reptiles use as hiding place. The rich vegetation cover is suitable as habitat for grass snake, viviparous lizard and slowworm. The area south-west of the path is characterized by a mosaic of open land and sparse trees (Fig. 1, green). Twice a year sheep are grazing there to prevent encroachment. Within this mosaic a small pond is located (Fig. 1, blue). It has a flat shore area and is therefore suitable for grass snake as reported by RADEMACHER (2001). The slowworm is recorded at the recultivated area, too. In the study area diverse reptile habitats can be created with relatively few resources:

1. Relocation of the compost heap based on a new "rotational compost concept" to avoid disturbances in the hibernating period and oviposition phase, and ensuring more diverse temperatures.
2. Optimization of dead wood inventory.
3. Removal of vegetation on the scree slopes to improve places for sun-basking of reptiles.

Figure 1: Detailed map of project area in the quarry Burglengenfeld

3. Measures: Optimization of reptile habitats

3.1 Compost as reptile habitat

All target reptiles need frost-free, protected places for hibernation. Naturally, they are found it in animal burrows, self-dug holes, crevices or hollow spaces in stumps (GÜNTHER 1996, BLAB & VOGEL 1996, HUTTER & FAUST 1994). Furthermore, grass snake has special demands on heaps as they are using them for ovipositon. A stable temperature of 20–30 °C, sufficient oxygen supply and high humidity are essential for a successful development of young snakes within the eggs (ASSMANN 1998). Sufficient supply of oviposition and hibernation sites are necessary for the reproductive success of the reptiles and the securing of a stable population. Naturally, these conditions are present in rotting vegetation, but this has become rare in current landscapes (HUTTER & FAUST 1994). It is well known that slowworm and grass snakes use compost heaps as alternative hibernation places as they provide warm conditions and protection against predators (GÜNTHER 1996, BLAB & VOGEL 1996, HUTTER & FAUST 1994, ZUIDERWIJK et al. 1993). Forest lizards often join in the shelters of slowworms (GÜNTHER 1996). For the grass snake compost heaps are also suitable as a place for oviposition. The higher temperatures accelerate not only breeding, but also increase the breeding success (LÖWENBORG et al. 2010). Anthropogenic created piles of shredded material (ASSMANN 2013), or branches and grass clippings (GOLDSCHMID 1997), have also proven as a winter quartier.

Compost heaps lose their suitability as oviposition place at the end of the decomposition processes, since no more fermentation is going on. The optimum temperature range (20–30 °C) for eggs of the grass snake prevails only in the 2nd and 3rd year within the cooling phase of compost. Although it is possible to partly ensure these temperatures by compost mixing, this would disturb the animals. Better control of habitat conditions is ensured through a rotational compost concept (MEYER et al. 2011). This offers permanent adequate space (mostly during the 3rd year of decomposition) with the required temperature range and thus can be used as a stable nesting site.

3.2 Innovative compost concept (Method 1)

In April 2016, the former compost heap (Annex, Fig. 3a) of the quarry were shredded and transported to the suggested disposal site. Based on our approach, the deposit of new material started at the new area close to the reptile habitat, i.e. the wooded area, the pond and the scree slopes (Fig. 1; orange and Annex Fig. 3b - 3c). Furthermore, it is easily accessible for machines necessary for doing compost work. At this place reptiles do not have to pass through the high-frequented storage place for fly ash to reach the compost. In total, an area of 240 m² was suggested for composting with a height of 3 m. This height ensures stability of the heap, so that support mechanisms are not necessary (MEYER et al. 2011). As shown in Fig. 2, the actual composting area is 30 m x 6 m with a 1 m wide buffer zone behind it. A stonewall consisting out of limestone blocks from the quarry itself frames the compost area. Although the stones will be subjected to weathering, their dynamic structure can offer habitat as well. Arising cracks can be used as shelter, and reptiles can heat up at the surface area. The buffer zone and the adjacent stonewall serve as a "shift space" giving the machines some material resistance for loading.

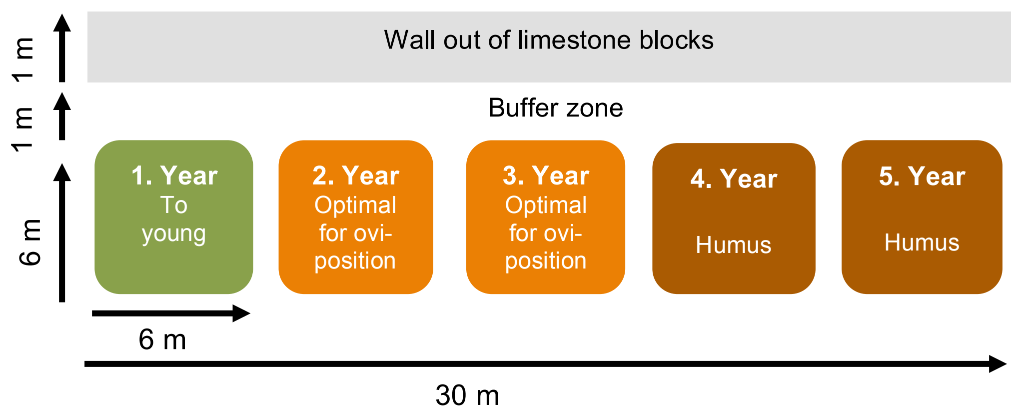
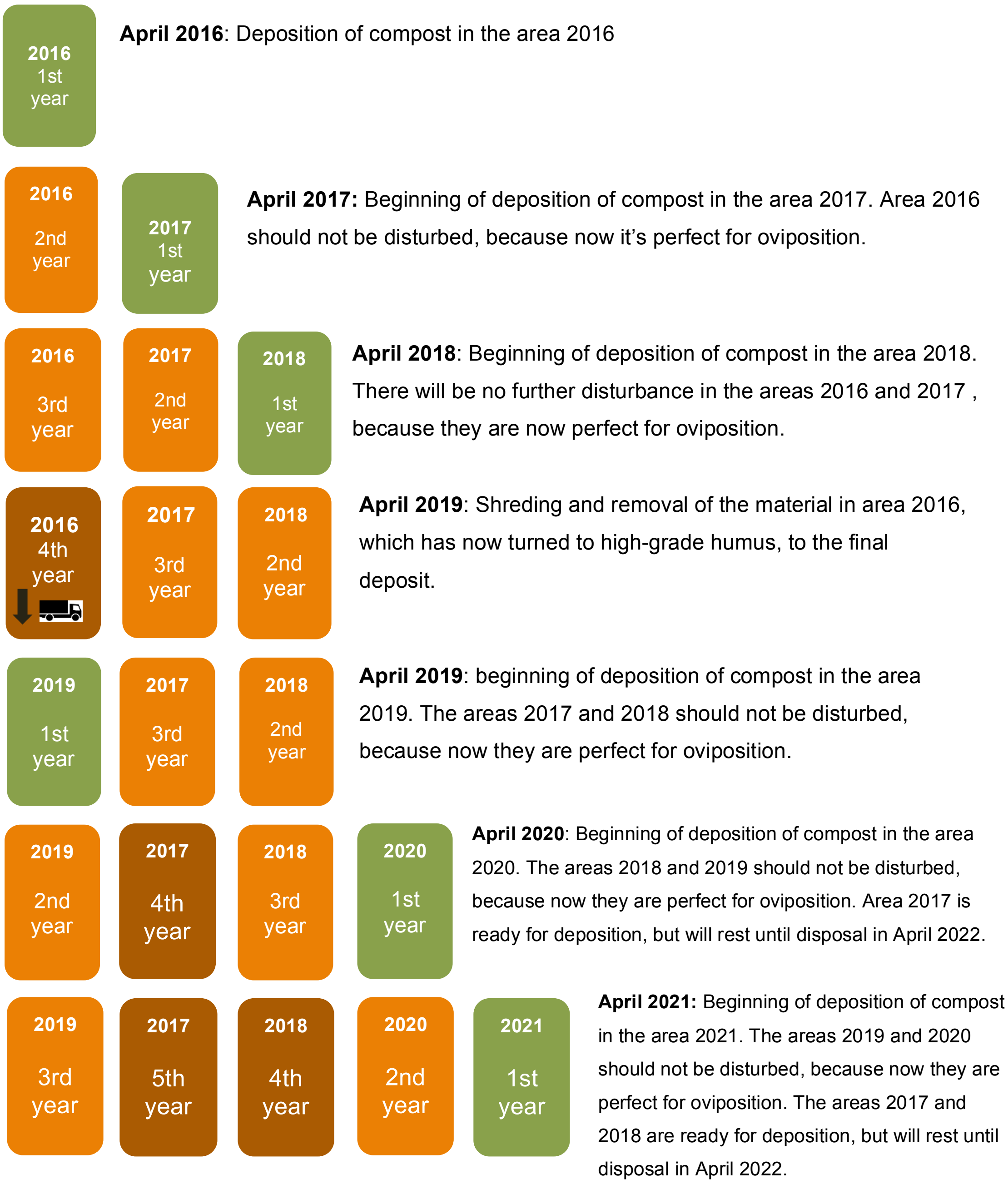


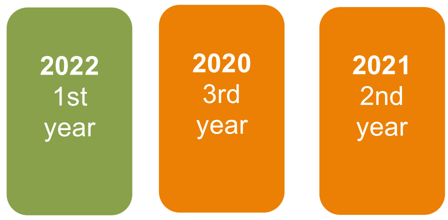
Figure 2: Graphical description of future compost storage location in the quarry Burglengenfeld

For future work a rotational management was adapted: The material was heaped up and annual accruing material will be complemented besides. As soon as one compost heap is decomposed (usually after 3–4 years), it can be removed and replaced by new material. This will only be deposited at the youngest compost heap. Thus, the piles of the 2nd and 3rd year will never be disturbed, and suitable microhabitats for oviposition of the reptiles are always available. The different compost stages are labelled by year, so that the employees know at which position they are allowed to deposit new organic waste. Fig. 3 explains the procedure based on a three-year cycle up to 2025: Every third year the humus will be completely removed, shredded and transported to the disposal site. We chose a three-year approach because an external company is doing the shredding, and annual shredding would not be an economic solution.

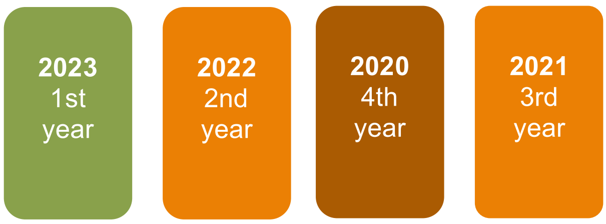
Figure 3: Illustration of the rotational compost concept up to the year 2025



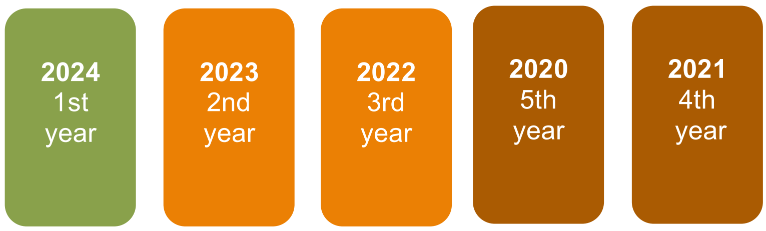
April 2022: Shreding and removal of the material of the areas 2017, 2018 and 2019, which has now turned to high-grade humus, to the final deposit.



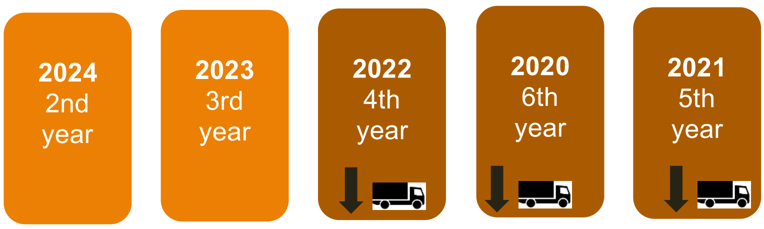
April 2022: Beginning of deposition of compost in the area 2022. The areas 2020 and 2021 should not be disturbed, because now they are perfect for oviposition.



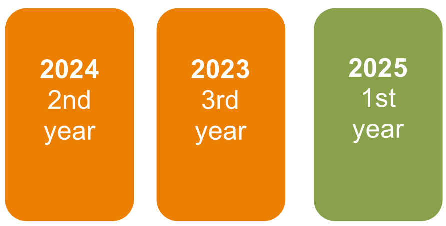
April 2023: Beginning of deposition of compost in the area 2023.The areas 2021 and 2022 should not be disturbed, because now they are perfect for oviposition.



April 2024: Beginning of deposition of compost in the area 2024. The areas 2022 and 2023 should not be disturbed, because now they are perfect for oviposition. The areas 2020 and 2021 are ready for deposition, but will rest until disposal in April 2025.



April 2025: Shreding and removal of the material of the areas 2020, 2021 und 2022, which has now turned to high-grade humus, to the final deposit.



April 2025: Beginning of deposition of compost in the area 2025. The areas 2023 und 2024 should not be disturbed, because now they are perfect for oviposition.

This cycle will continue in this way the following years.

1st year: Compost is still to young (hot)

2nd / 3rd year: Compost has optimum temperature for oviposition

4th/ 5th year: Compost already is in decomposed

3.3 Optimization of dead wood (Method 2)

Deadwood is an excellent structure for sun-basking, with moderate heat-storing capabilities. Reptiles use bark, root plates, dead wood piles or tree stumps, which can also be used as hiding place (WILLIGALLA et al. 2011). Several authors suggested the improvement of dead wood to provide hiding and basking areas for reptiles, such as slowworm or smooth snake (BLOSAT & BUßMANN 2011, BUßMANN et al. 2011).

Because of that, we identified suitable pieces of deadwood (e.g. tree stumps or rootstocks) before the compost was removed. Then we used the deadwood to improve the three existing deadwood piles in the project area (Fig. 1, yellow points). Before these measures were completed they consisted almost exclusively out of thinner branches (Annex, Fig. 4a). Now they are characterized through a variety of dead wood consisting out of different diameter. Basking places are offered through the added large tree stumps and various chracks provide protection of potential enemies (Annex, Fig. 4b and 4c). In future, the relating material of shrub clearences should be used to further optimize the piles (BUßMANN & SCHLÜPMANN 2011). After a windfall in July some of the fallen trees have been used to further optimize the piles (Annex, Fig. 4d). They were complemented besides the existing dead wood to minimize disruption.

As an additional sun places we placed two large tree trunks (Annex, Fig. 5a and 5b) in the bank area of the pond. After the windfall in July they were used to further optimize these structures (Annex, Fig. 5c). Especially, the grass snake benefits from these measures. It prefers shallow shores for hunting and basking (HACHTEL & DALBECK 2006, HACHTEL et al. 2006, BLOSAT et al. 2011).

3.4 Prevention of woody encroachment (Method 3)

Besides deadwood piles mainly rocky slopes represent important places for basking of reptiles (BLAB & VOGEL 1996). Therefore, steep, sunny, south-exposed areas should be promoted (HACHTEL & DALBECK 2006). Keeping those areas open is of central importance (BLOSAT & BUßMANN 2011, BUßMANN et al. 2011, BUßMANN & SCHLÜPMANN 2011). Even the 'Artenbiotopschutzprogramm Schwandorf' recommends the clearing of encroached, shaded rocky slopes and screes. Especially non-native trees and shrubs, such as the black locust should be removed (StMUGV 1997).

In our project area we removed the shadowing vegetation (Annex, Fig. 6a) and exempted bare scree (Annex, Fig. 8b and 8c). In future, newly occurring vegetation should be removed in intervals of 3 years, while vegetation cover should never exceed 40% of the slope area (KAISER 2013). In addition, gravel surface should be disturbed as little as possible (HACHTEL & DALBECK 2006). Therfore, we blocked the path for vehicels (Fig. 1, yellow; Annex Fig. 6d). After a few weeks Mr. Muck already saw a grass snake in that area.

4. Time management and budget

For the implementation of the proposed measures a good time management is of central importance. Thus, the loss of wintering reptiles or their clutches can be prevented. Therefore, excavations have to be avoided from November to March (BLAB & VOGEL 1996). At this time, the four species are hibernating and not active and mobile (Tab. 1).

Compost work

Removal of compost and dead wood should be dispensed from July to August, as eggs of the grass snake are present at this time. Large disturbances like application and removal of whole areas should therfore be avoided. Because of the regulary occurring grass clippings during quarry operation this can be exeptionally placed at the heap externals. Nevertheless, optimally compost work should be carried out in April (Tab. 2). Beginning of the rotating concept was 13rd April 2016. The area for the new compost was calculated according to the quantities given by the quarry Burglengenfeld (Tab. 3)

Table 1: Overview of annual cycle of reptiles according to HUTTER & FAUST (1994), BLAB & VOGEL (1996) and GÜNTHER (1996)

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Hibernation											
Hibernation											
Hibernation				Egg cluches							
Hibernation											

Common lizard Slowworm Grass snake Smooth snake

Table 2: Timetable of methods

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Removal of vegetation			root area affected								
				Compost work							
			Grazing by sheep								

Table 3: Calculation of needed compost area for a 3-year-removal cycle

Currently	850 m³ waste after six years	284m²
New process	removal of waste material every third year	142m²
Concept requirements	5 splitted areas 3 m high (36m² each - rounded)	180m²
Additional	buffer zone 1m & stone wall 1m	60m²
Overall	**required compost area**	**240m²**

Conditioning of dead wood pile

At 13 April the dead wood piles have been improved (together with compost measures), so they can be used by the reptiles for sun-basking. In principle, the creation is possible in all seasons, as long as no existing reptiles locations affected negatively. In the ongoing quarry operation new accuring material should be used to further optimize the piles.

Removal of woody plants

Unless the root zone is not affected by the measure shadowing trees can be removed from early November to late February outside the activity time of the reptiles (Tab. 1; ROTH 2011, HUTTER & FAUST 1994). However, if the root area is affected, the first warm days in April should be selected for the implementation of the action (GLANDT et al. 1995).

Working hours, work tools, budget

The direct cost of the proposed measures will amounts to:

One-time measures	**Working hours (h)**	**Costs (€/h)**	**Total costs (€)**
Removal of wood and placing deadwood	12	35	420
Cutting and disposal of the trees at the new compost site	8	35	280
Placement of rocks	8	35	280
Total	**28**		**980**
Annual measures			
Large wheel loader for compost	2	50	100
Total	**2**		**100**
Measures every third year	**Working hours (h)**	**Costs (€/h)**	**Total costs (€)**
Mobile shredder for compost material	10	50	500
Mobile excavator for loading shredder	10	50	500
Wheel loader for material transport	6	50	300
Total	**26**	150	**1300**

6. Value to biodiversity

Not only reptiles use these anthropogenic heaps of organic waste. Furthermore, all decomposing species and their predators such as woodlice, worms, millipedes, springtails, snails and insect-eating birds, various beetles (for example rose chafer) and their larvae profit of the habitat resource (LFU KULMBACH 2016; ASSMANN 2013). In the Fichtelgebirge twelve different beetle species, including the red list species *Agaricophagus cephalotes* were found in different compost heaps (RÖSSLER 2000). Also pseudoscorpions that feed on springtails live in compost piles (BLICK & MUSTER2003). Mice and shrews use compost piles for hiding and nesting (SOZIALER GARTEN & SENSE.LAB 2014). Many of these species are prey of hedgehogs or smooth snake (ALFERMANN et al. 2013, NABU LEIPZIG 2013). Through the strategic positioning of dead wood, the creation and maintenance of a mosaic of sunny and shady places, and a thoughtful compost management all requirements for the life cycle of the target reptiles are met with modest efforts and without introducing materials to the quarry. This plan not only creates additional habitats for the selected reptiles, but also for other species. To measure the success of the project, a reptile mapping should take place in 2017. Moreover, the compost heap can be monitored for eggshells after hatching of the snakes. Furthermore, insect traps or bird mapping could verify the effect of the improved compost management on other biodiversity.

With this ecologically use of organic waste HeidelbergCement increases biodiversity without additional costs. Our approach can also be transferred to other mining sites within the company or of other companies, because unused organic waste is common at other sites as well. It demonstrates a responsible interaction with the environment and its animal inhabitants.

To be kept and filled in at the end of your report

Project tags (select all appropriate):

This will be use to classify your project in the project archive (that is also available online)

Project focus:

- ☒Biodiversity management
- ☐Cooperation programmes
- ☐Education and Raising awareness
- ☒Endangered and protected species
- ☐Invasive species
- ☐Landscape management - rehabilitation
- ☒Rehabilitation
- ☒Scientific research
- ☐Soil management
- ☐Urban ecology
- ☐Water management

Flora:

- ☐Conifers and cycads
- ☐Ferns
- ☐Flowering plants
- ☐Fungi
- ☐Mosses and liverworts

Fauna:

- ☐Amphibians
- ☐Birds
- ☐Dragonflies & Butterflies
- ☐Fish
- ☐Mammals
- ☒Reptiles
- ☒Spiders
- ☒Other insects
- ☐Other species

Habitat:

- ☐Cave
- ☐Cliffs
- ☐Fields - crops/culture
- ☐Forest
- ☒Grassland
- ☐Human settlement
- ☒Open areas of rocky grounds
- ☐Recreational areas
- ☒Screes
- ☒Shrubs & groves
- ☐Soil
- ☐Wander biotopes
- ☐Water bodies (flowing, standing)
- ☐Wetland

Stakeholders:

- ☐Authorities
- ☒Local community
- ☒NGOs
- ☐Schools
- ☒Universities

6. Annex

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Table 1: Overview of characteristics and habitat requirements of the target species

according to HUTTER & FAUST (1994), BLAB & VOGEL (1996); GÜNTHER (1996).

Photo sources: Slowworm: flickr - Frank Vassen; common lizard: s. Pschonny; gras snake: flickr - Magnus Hagdorn; smooth snake: flickr - Frank Vassen

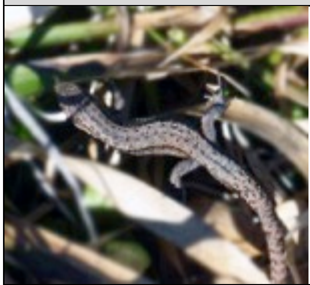
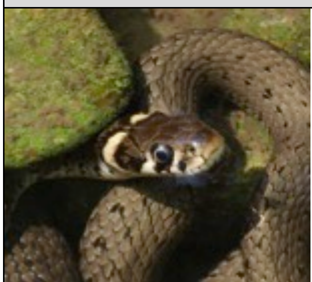
Viviparous lizard (Common lizard)	
	Close and dense vegetation, edges, rather moist habitat Sunning place: Sun-exposed places Hiding places: Beneath blocks, dead wood, burrows Oviposition: Ovoviparous Food: Arthropods Red List Germany: No
Slowworm	
	Close and dense vegetation, edges, rather moist habitat Sunning places: No sunning places Hiding places: Dead wood, beneath blocks, compost heaps Oviposition: Ovoviparous Food: Earthworms and slugs Red List Germany: No
Gras snake	
	Half-open and open places with water vicinity Sunning places: Dead wood, heeps of reed, raw floor Hiding places: Blocks, crevices, burrows Oviposition: Dead wood and plant residues Food: Amphibians Red List Germany: Vulnerable
Smooth snake	
	Half-open and open, dry places, edges (forest, bushes) Sunning places: Stone blocks, dead wood Hiding places: Crevices, walls, burrows Oviposition: Ovoviparous Nahrung: Lizards, snakes Red List Germany: Endangered

Figure 1: Barriers, potential habitats and stepping stone habitats as well as documented species in the surrounding area (layer: LfU 2016, Bingmaps 2016)

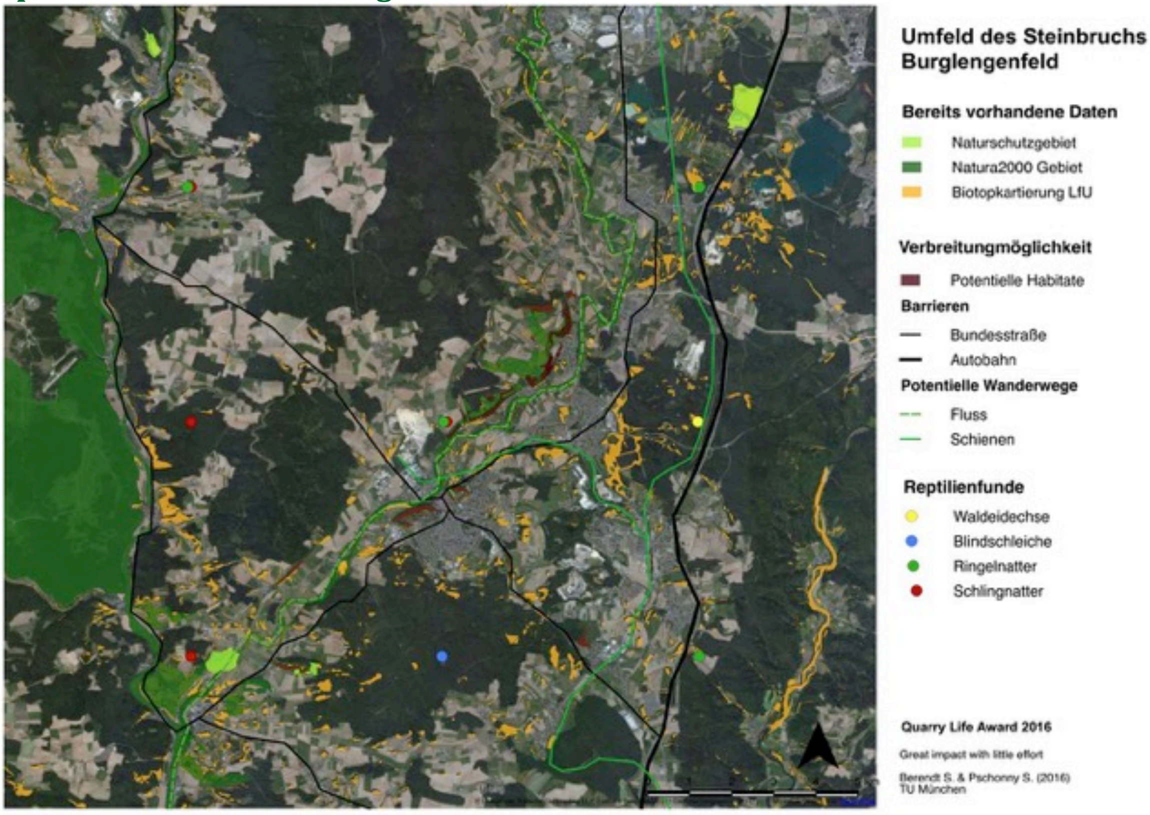


Figure 2: Suitable habitats (brown) in the immediate surrounding north-east of the quarry. Source: layer: LfU 2016, Bingmaps 2016

Photo documentation

Figure 3a: Former place for the compost at the scree slope near to the the high-frequented storage place for fly ash (January 2016)

Figure 3b: Compost in April 2016

Figure 3c: Compost in July 2016

Figure 3d: Vision of the new compost: In 2020 five heaps are present offering suitable and undisturbed places for hibernating and oviposition

Figure 4a: Before completing our measures dead wood consisted only out of thinner branches

Figure 4b: To optimize dead wood heaps we complemented larger logs and rootstocks (April 2016)

Figure 4c: Large logs offer sunny spots for heating up while crevicies can be hiding places (Photo: April 2016)

Fugure 4d: If new dead wood is created in the quarry it is used to further optimize and maintain the dead wood piles (Photo: July 2016)

Figure 5a: Optimization of the shore area through placement of logs (April 2016)

Figure 5b: Large logs provide sunning space for the grass snake

Figure 5c: Dead wood at the pond is optimized within the ongoing quarry operation (July 2016)

Figure 6a: Scree slope before measures: Shadowing vegetation left no space for sun-basking on the scree slope (October 2015)

Figure 6b: Scree slope after vegetation removal (April 2016)

Figure 6c: Scree slope in July 2016 – newly occuring vegetation will be removed in intervals of 3 years

Figure 6d: The path is now blocked for vehicels