Visitors at risk and heritage in peril? A case-study of Paris forbidden “catacombs”.

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Abstract:

Paris is built upon an almost 300-kilometre long quarries network which reflects a part of the city’s history. While the access to most parts of it is forbidden due to its hazard, this underground network attracts many illegal visitors called Cataphiles. This research aims to investigate the risks threatening illegal visitors and those affecting the heritage of the catacombs. In order to get an overall picture of those risks, two ‘formal’ risk assessments are used, as well as one interview-based data set in order to study illegal visitors’ risk perception. Apart from analysing the main risks to the heritage and the illegal visitors, this study discusses the risk perception results alongside existing literature. It also provides a discussion on the links between the risks for the visitors and for the heritage. The adoption of this dual approach enables the identification of solutions encompassing both a visitor safety perspective and a heritage protection approach.

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Acronyms

AHD: Authorised Heritage Discourse

DRIEE: Direction régionale et interdépartementale de l'Environnement et de l'Énergie (Regional and Interdepartmental Direction for the Environment and the Energy)

IGC: Inspection Générale des Carrières de Paris (Quarries Inspection Office of Paris)

SEADACC: Société d'études et d'aménagement des anciennes carrières des Capucins (Association for the studies and management of Capucins ancient quarries)

Urbex: Urban exploration

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1. Introduction

1.1. Background, Context and Research Aim

With its rich history and high concentration of tangible cultural heritage sites and museums, Paris is one of the most renowned destination in the world (The Local, 2019). Yet, beneath its large avenues and tourist attractions, Paris quarries show a darker side of the City of Light, which appeals to more adventurous visitors (Fort et al, 2014:7).

Built upon an almost 300-kilometre long quarries network, Paris *"with its galaxy of perforations, is like a great hunk of Swiss cheese"* (Hunt, 2019). During the Antiquity, open-sky quarries started to be carved in order to extract sandstone, limestone, clay and gypsum, which were used to construct the Roman city of Lutetia - present-day Paris (Rayzal, n.d.). From the 13th century, due to an increasing demand and in order to save lands up on the surface for agricultural purposes, underground galleries started to be dug (Fort et al, 2014; Clément and Thomas, 2016; Rayzal, n.d). The rock blocks extracted at that time particularly served to erect the very famous sites of Notre-Dame, the Louvre and the Palais Royal. While quarries were progressively abandoned and forgotten between the 16th and 18th centuries, problems started to arise due to cavities subsistence and urban sprawl. For instance, in 1774, a 25 meter deep and 300 meter long collapse took place on a road of the Left Bank of the Seine and in 1778, seven people died in another collapse in Ménilmontant district (Rayzal, n.d.). After several dramatic collapses, mining operations in the quarries were forbidden and a Quarries Inspection Office (*Inspection Générale des Carrières – IGC)* was created to monitor and conduct reinforcement work of the cavities (Fort et al, 2014:9, Rayzal, n.d.:20).

At the same time, cemeteries in Paris, especially *Les Innocents* cemetery located in the city centre and neighbouring the principal Parisian marketplace "les Halles" started to become overcrowded, creating significant health issues. It became urgent to evacuate the human remains from this cemetery when the weight of a mass grave caused the collapse of a basement wall in a private property in 1780. It was decided to transfer all the bones to Paris' quarries, transforming a part of the quarries into an ossuary. In 1809 this ossuary was organised into a museum by Louis-Etienne François Héricart de Thury, the IGC director of that time (Rayzal, n.d, Fort et al, 2014:11). This museum took the name of "Paris Catacombs", in reference to Rome Catacombs. However, they are technically not catacombs according to the etymology of the word, which comes from the Greek *katá-* (down) and the Latin *tumbae* (tombs) (Hunt, 2019; Rayzal, n.d.). Moreover, both the museum and the entire tunnel network being commonly called 'Catacombs', while the former is only a small section of the latter.

Today, the Catacombs Museum welcomes more than 500,000 visitors per year while the rest of the quarries have been abandoned despite presenting both natural and cultural heritage characteristics. Indeed, various geological strata are visible including Lutetian Limestone[1], and the quarries are part of the history of the city and its inhabitants (Rayzal, n.d.; Thomas and Vanara, 2018). Moreover, its access has been forbidden due to its hazard. Yet, this illegal part is attractive to many people, commonly called the "Cataphiles".

This research aims to better understand the risks for the illegal visitors, as well as those affecting the heritage of the forbidden part of Paris catacombs. Indeed, Cataphiles are taking risks while visiting the catacombs illegally – might they be aware of them, or perceive them differently from the authorities. as a result, not only do they put themselves in danger, but also damage the heritage in multiple ways. Still, this heritage seems to be neglected by authorities themselves and one can wonder what its value is, and therefore, what level of conservation should be applied to it.

1.2. Research question and objectives

The overall research question is **"what are the risks for the illegal visitors and for the heritage in the case of Paris quarries?".** To answer this question, the research has three objectives:

- Analysing the risks for the illegal visitors while understanding their perception and awareness of the risks;
- Assessing the risks that quarries are exposed to as well as understanding how those risks are perceived by the different stakeholders;
- Discussing the benefits and challenges to adopt a dual approach of risk management (through the lens of visitor safety and of heritage protection).

[1] 45 million years ago, Paris region was covered by a warm sea which deposited Lutetian limestones. This stone was used to build Paris and gave it is unique architectural style (Blanc, Holmes, Harbottle, 1998)

1.3. Thesis outline

Following this first chapter, which offered background information leading to the formulation of the research question as well as its aims and objectives, the thesis is divided into 6 other chapters:

- **Chapter 2** introduces several concepts and theories underpinning the research;
- **Chapter 3** describes the methodology used for this research, as well as its limitations and obstacles;
- **Chapter 4** presents a literature review on topics relevant to the research, and allows to identify gaps in the literature;
- **Chapter 5** presents the main results of the thesis and their analysis through two formal risk assessments and one interview-based data set.
- **Chapter 6** summarises and discusses the key findings and presents an interpretation of the key results.
- **Chapter 7** concludes the thesis with the key outcomes of the research and some suggestions for future studies.

2. Conceptual framework

In this chapter, some key concepts providing a theoretical background for this research are outlined. The conceptual framework is comprised of the following concepts: "Cataphilie", risk assessment, and heritage.

2.1. "Cataphilie"

The activity of trespassing in Paris quarries, called "Cataphilie" is considered to be a form of urban exploration, an activity consisting of exploring urban spaces and especially trespassing into abandoned and disused areas or buildings which are marginalised from urban planning operations (Lebreton, 2015:45; Stones, 2016:302). Considering the nature of the quarries, this activity has also been defined as recreational caving (Wilson, 2012:641) or as urban speleology (Lebreton, Héas, 2007:345). It could also be suggested that this activity is related to dark tourism due to the link of the site with death, with the presence of human bones (Fonseca et al, 2016, Yan et al, 2016). However, Dauphin (2015:17) explained that Cataphiles do not seem to have a particular interest in ossuary and death. Due to its illegal aspect but also to the minority of practitioners, urban exploration (and thus, 'Cataphilie') can be qualified as a deviant behaviour: Cataphiles are "breaching socially accepted boundaries" (Fulton 2017:192, Becker, 1963).

2.2. Risk assessment

In the classic definition of risk assessment, risk is defined by the combination of a hazard, its probability of occurrence and the vulnerability of an exposed asset. (Coppola, 2011; Corneloup, Soulé, 2002:35; Wisner et al, 2000). Guidelines have been created such as ISO 31010, to help experts with assessing risks. Classic risk assessment has become *"the dominant definition of risk in the technical literature"* (Hansson, 2010:232). However, Slovic (1999:697) argued that the public does not necessarily follow this definition of risk, and thus divergences can exist between experts and the public. While classic risk assessment views risk as objectively given, it has been argued that risk can be seen as a social construction with psychological, social, political, and cultural factors influencing risk perception of people (Slovic, 1999:697; Slovic, 2001:19 Hansson, 2010:231; Corneloup, Soulé, 2002:33; Renn, 1985; Yang, Nair, 2014:323). Contrary to the expert risk assessment definition, a qualitative assessment based on heuristics, cognition and intuition is adopted. For instance, it includes factors such as the familiarity and controllability of the hazard, as well as the level of trust in science and public

authorities (Renn, 1985; Vojinovic et al 2016:592-593; Slovic, 1999:697). Risk perception based assessments have proven to be useful to understand how the public identifies and assesses risks. Indeed, people can be subject to some psychological or cognitive biases when assessing risks, such as available heuristics[2], positive illusions[3], risk ambiguity aversion[4] and familiarity principle[5] (Coppola 2011; Johnson & Levin 2009; Meyer, 2006; Becker, 2014).

2.3. Heritage

Heritage signifies "something inherited" (Vecco, 2010). According to Mason (2008), heritage encompasses historical, cultural, symbolic, social and aesthetic values:

- Historical values are those related to the past. They often have an educational perspective as they offer *"the potential to gain knowledge about the past in the future"* (Mason 2008:104). Paris quarries have a historical value since they have been used for different purposes throughout history. Thus, the remaining imprints in the quarries offer a testimony of many historical events related to the history of Paris (see Appendix 1) (Dauphin, 2015:15 ; Peirazeau, Gelez, 2017:8).
- Cultural and symbolic values are *"those shared meanings associated with heritage that are not, strictly speaking, historic"* (Mason 2008:104). The rich symbolic value of the quarries is for instance represented by the renaming of some places in the quarries according to people sensibility (Lebreton et al 2008:219).
- Social values refer to the use of a site and include place attachment. Cultural heritage sites imply a sense of belonging and can be interpreted as a shared bound within a community. Therefore, it is often an important component of a community's identity (Stanton-Geddes and Salman 2017; Jigyasu, Rohit, et al. 2013; Pereira Roders and Van Oers 2011; Mason 2008:105). Paris quarries have been subjected to re-appropriation by many Cataphiles (Peirazeau, 2015:66; Lebreton, 2015:51).
- Aesthetic values refer to human's senses (vision, hearing, smell, taste, touch). Mott and Roberts (2013:231) noted the high aesthetics sensibility of urban explorers for "decay". In the context of Paris quarries, Lebreton et al (2008:218) quoted one interviewed Cataphile who was describing a certain well-being when he was in contact with the smell and the touch of the quarries' stone walls.

[2] Available heuristics: Tendency to get stuck to what happened recently, of seeing the future as an extrapolation of the present
[3] Positive illusions: Underestimating our likelihood of being affected by a risk
[4] Risk ambiguity aversion: Tendency to overestimate unknown risks
[5] Familiarity principle: Being used to something and so not being careful anymore about it

As this definition of cultural heritage presupposes, cultural heritage encompasses more than material items. A distinction is often made between tangible heritage, which are material elements such as historic cities, collections, archives, even natural landscapes and technological achievements, as opposed to intangible heritage which includes immaterial aspects like knowledge, skills, traditions, craftsmanship, beliefs, social practices and values (Jigya-su, Rohit, et al. 2013; Turnpenny, 2004: 299). The subculture created by Cataphiles can be considered as a form of intangible heritage, especially since Cataphiles share, among other things, a common knowledge and vocabulary (Peirazeau 2015). This leads to another characteristics of Paris quarries: it is a living heritage. Cataphiles are leaving contemporary imprints in the quarries which have an artistic value for some people (see Appendix 2). (Dauphin, 2015:15; Peirazeau, Gelez, 2017:19). According to Peirazeau (2015), the quarries are in constant evolution with artistic production, which means that perhaps new heritage is being formed as we speak.

In this research, both the historical and contemporary heritage were equally considered, without any value judgement. This neutral standpoint was adopted in order not to favour a type of heritage over the other, so that it respects different sensitivities to heritage that people might have.

3. Research methodology

This chapter describes the methodology underpinning this thesis. The research draws on a case study of Paris quarries, and is based on a qualitative approach which includes the collection of primary data (interviews) and secondary data (literature review as well as videos and blogs analyses).

3.1. Overall methodological approach

A case-study approach was adopted for this research work. The case-study research method has been defined by Yin (1984:23) as *"an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident*". Case-studies have been widely used in social science studies because they enable holistic and in-depth study of a phenomenon (Zainal, 2007:1; Alnaim, 2015:29). They are particularly useful in multi-stakeholders environments as they *"help to explain the complexities of real-life situations"* (Zainal, 2007:4). Therefore, this approach was considered to be appropriate for studying different perspectives and risk perceptions.

In the present research, Paris quarries were chosen as a case-study due to their unique combination of interesting heritage characteristics, and for being forbidden to the public and yet illegally visited by many people. Despite their uniqueness, it is believed that Paris quarries can exemplify a representative case of an urban exploration site which often presents similar characteristics as the ones listed above.

Paris quarries are mainly located on the Left Bank of the Seine, in the South of Paris. Therefore, the study focuses mostly on the quarries network covering the 5th, 6th and 14th districts of Paris, often called the *Grand Réseau Sud*[6] (see Figure 1). As aforementioned, 'Paris quarries' in this study designate the informal part of the quarries and do not encompass the Catacombs Museum and the Capucins quarries which status are significantly different. Indeed, the Catacombs Museum is a public museum while the Capucins quarries have been recognised as *Monument Historique*[7] in 1999 and are owned by an association, the SEADACC[8].

[6] Grand Réseau Sud (GRS): Large South Network
[7] '*Monument Historique'* is a French designation given to some heritage sites in France. It recognised the cultural or historical importance of a site.
[8] SEADACC: *Société d'études et d'aménagement des anciennes carrières des Capucins* (Association for the studies and management of Capucins ancient quarries)

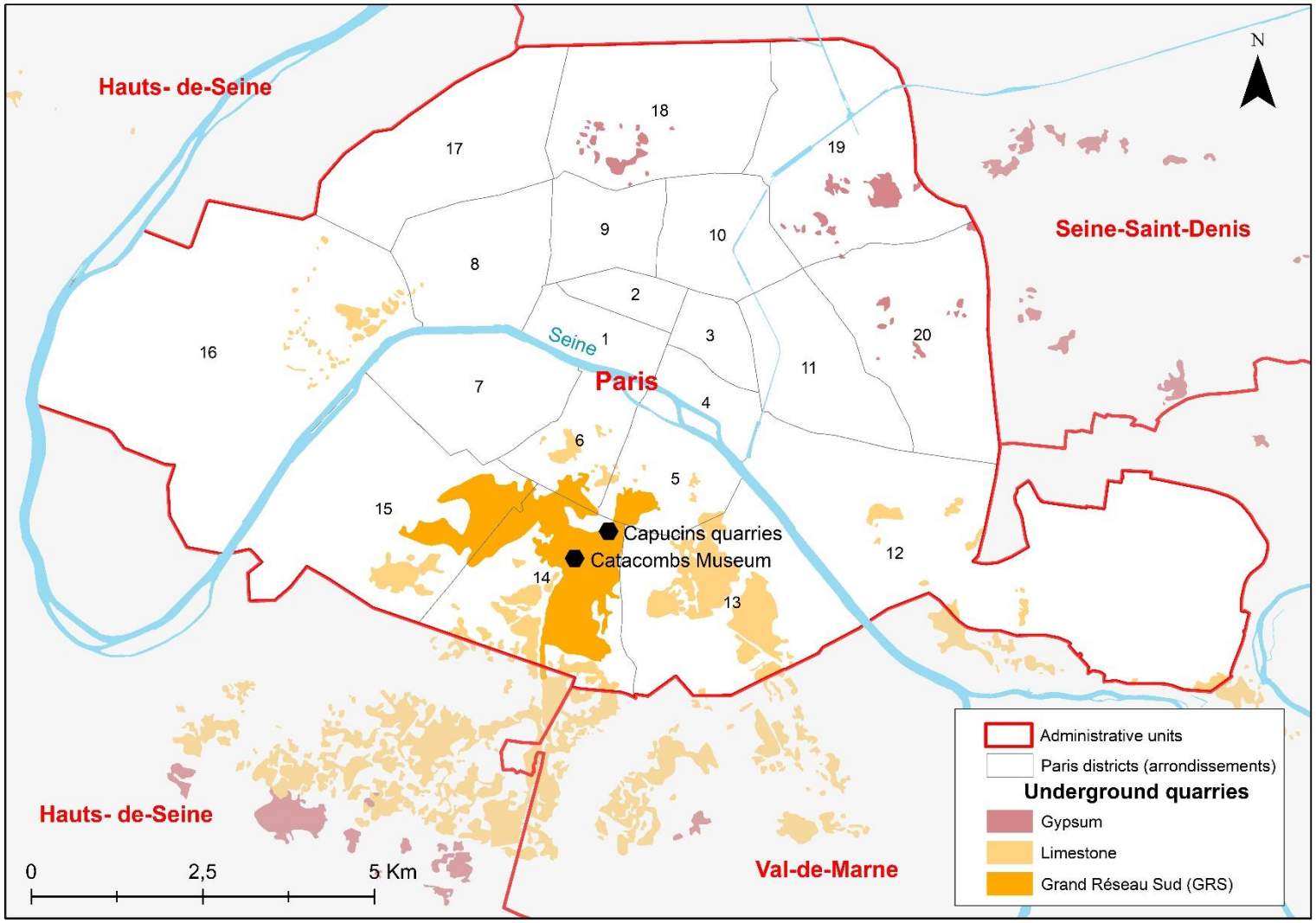

Figure 1: Map of Paris quarries. Map layer: Charlotte Fafet; Data source: © Yann Bussière (underground quarries);Mairie de Paris (administrative units)

3.2. Collection of data

3.2.1. Through interviews

Most of the data was collected through semi-structured interviews conducted in French. Interviews were chosen as primary data because they allow people to explain their experiences and motives in their own words (Valentine, 2013:111). Thus, they are particularly suitable for studying risk perception, as well as the way people value heritage sites. Furthermore, semi-structured interviews are flexible and thus allow interviewees to "*diverge in order to pursue an idea or response in more detail*" (Gill et al, 2008). It can provide the interviewer with relevant themes for the research that might not have been considered otherwise.

In total, 11 interviews were conducted (see Appendix 3). Seven of them were face-to-face and four were arranged by phone in order to accommodate with respondents' schedule or preferences. At the beginning of each interview, respondents were informed that their anonymity would be preserved and that they did not have to answer questions that they were not feeling comfortable with. Moreover, interviews were recorded with the respondents' given consent and were then transcribed. Recording interviews was chosen over taking notes, as it helps having a more conversation-like interview. Moreover, *"it produces a more accurate and detailed record of the conversation"* (Valentine, 2013:123) by preventing omissions and potential errors. It also allows to further analyse the interview afterwards, in order to notice details concerning the interviewee's intonations and reactions (Barriball and While, 1994). Different interview guidelines were prepared in order to fit with the profile of the interviewees (see Appendix 4). They were not disclosed beforehand in order to avoid "premeditated" answers.

Peirazeau (2015:81) distinguished between people allowed to go in Paris quarries and illegal visitors. Both were interviewed in this research, since they are likely to have divergent perspectives and point of views. The comparison of the interviews is expected to reveal eventual competing discourses and to provide information regarding risk perception.

Identification of official stakeholders

Relevant authorities were identified through web search and thanks to information given by the respondents. Figure 2 offers an overview of those official actors and their 'roles' in relation with the quarries. The Catacombs museum and the association 'SEADACC'[9] do not play a role in the illegal parts of the quarries. However, they were identified as relevant stakeholders as they could provide a useful perspective on the heritage value of the quarries and the risks this heritage site is exposed to.

Selection of illegal visitors

Concerning illegal visitors, Cataphiles have been described as a subgroup of urban explorers who frequent Paris quarries (Peirazeau, 2015:59; Garrett, 2011:271; Glowczewski, Matteudi, 1983:6). Peirazeau (2015:81) noticed that not everyone going in the quarries do it on a regular basis, and differentiated Cataphiles from 'tourists' by the frequency of visits and their independence to navigate the quarries (see "approximate frequency of visits" and "alone or with people" columns in figure 3). Dauphin (2015:17) made a similar point by differentiating 'neophytes users', 'intermediate users', 'experts' and 'experts-contributors'. Therefore, the frequentation criteria was considered important for in the selection of the interviewees.

Illegal visitors encompass every person infringing the law by trespassing in Paris quarries. In this regard, students of the Ecole des Mines[10] are an ambiguous stakeholder as they are authorised to go in the quarries during the introduction week of their first year of school[11]. In this study, the interviewed students of the Ecole des Mines were considered as illegal visitors, because they continue going to the quarries aside from their introduction week. Consequently, illegal visitors constitute a heterogeneous group, an aspect which was considered when selecting people to interview in order to illustrate as much as possible the different opinions and perspectives on risks and heritage that people might have (see figure 3).

[9] The SEADACC is in charge of the management and preservation of the Capucins quarries
[10] *Ecole des Mines* is a renowned French engineering school.
[11] *Ecole des Mines* has important historical links with the quarries. For instance, most directors of IGC are former students of Ecole des Mines. Moreover, topographic exercises were organised in Paris quarries in the past (before the access was forbidden). Bringing new students during the introduction week is a way to perpetuate the tradition.

Name	Role in/with Paris quarries	Inputs for the research	Interview
Catacombs museum	The museum is in charge of the conservation of the ossuary which is just a small section of the quarries. The ossuary is disconnected from the rest of the quarries network, as it was walled up when turned into a museum. Therefore, it does not have a direct role in the illegal part of the quarries.	→ Heritage value of the quarries (and value of the ossuary compared to the rest of the quarries) → Issues related to the conservation of subterranean heritage sites	Yes
Quarries Inspection Office (IGC)	IGC is in charge of controlling and monitoring the state of Paris quarries. They create hazard maps, and are mainly focused on risks that quarries can create on the surface.	→ Heritage value of the quarries → Risks that people exposed themselves to when going in the quarries → Risks the quarries are exposed to (heritage protection perspective)	Yes
Paris Municipality	The direction for occupational health and safety risks at the Paris Municipality is in charge of studying and monitoring risks that people working at IGC are or can be exposed to.	→ Risks taken when going in the quarries. Some parallels can be made between the risks IGC workers and illegal visitors are exposed to when going underground.	Yes
Police, ('Cataflics')	The 'cataflics' (which can be translated in English by 'Cata-cops') are the special police unit in charge of the surveillance of the quarries.	→ Risks taken by illegal visitors	No
Fire-officers	Fire officers are often the first one called when a major accident happens in order to rescue people.	→ Accidents related to the quarries	No
SEADACC	The SEADACC is in charge of the management and the preservation of the Capucins quarries, which are located under 'Cochin' Hospital. They do not have a direct role with the illegal part of the quarries since they walled up this part of the quarries network.	→ Heritage value of the quarries → Issues related to the conservation of subterranean heritage sites and more especially Paris quarries	No
DRIEE	The Regional and Interdepartmental direction for the Environment and the Energy is working closely with IGC and is in charge of the legislation related to the surface risks created by the quarries.	→ Surface risks and legislation	No

Figure 2: Official stakeholders mapping

	Age range	Mine student	Approximate frequency of visits	Alone or with people	Category
Visitor 1	30-35	No	Approximately 3 times a week when living in Paris. Now 2 or 3 times a year	With people (independent)	Expert
Visitor 2	25-30	Yes	5 or 6 times in total	With people (dependent)	Tourist
Visitor 3	25-30	No	2 or 3 times this year, also going to many other abandoned and forgotten sites	Alone or with people (independent)	Intermediate user
Visitor 4	18-24	Yes	3 times per week but less and less	Alone or with people (independent)	Expert
Visitor 5	18-24	Yes	One to two times per week, but less and less	With people (independent)	Expert
Visitor 6	25-30	Yes	Once every two weeks during four years	With people (independent)	Expert
Visitor 7	+50	No	From 2 times a month to 10 times a week, for 35 years	Alone or with people (independent)	Expert / Expert contributor
Visitor 8	25-30	No	Max. two times a month, now less (several months without going)	Alone or with people (independent)	Intermediate user

Figure 3: Profiles of the interviewed illegal visitors

3.2.2. Through videos and blogs

Blogs and videos were identified as an interesting source of data in the early stages of the research process. Since the late 2000s, blogs have been considered as *"contemporary 'documents of life'"* in the way that people spontaneously talk about their experiences and feelings (Hookway and Snee, 2017:381). Personal materials such as diaries, letters and blogs have been particularly appreciated in sociology as they enabled accessing to the subjectivity of individuals and their representations (Thomas and Znaniecki, 1958, Hookway and Snee, 2017). They give *"access to a less-perfect, less managed and potentially more honest account of self and experience"* which is particularly useful when approaching a 'removed community' (Hookway and Snee, 2017:382). They are particularly interesting to supplement interviews as they limit the problems related to retrospective and memory (Hookway, 2008).

A lot of Cataphiles document their experiences with videos, photos and texts, which helps accessing this 'hidden' community. Blogs were found through Google searches, and videos on YouTube, using terms such as *"Urban exploration Paris quarries"* or equivalent words.

3.2.3. Through the review of existing literature

Existing literature was reviewed for this research to link the research with different disciplines. Only a few studies focused on the heritage value of sites similar to Paris quarries as well as the risks to which they are exposed to, and even fewer addressed the risk perception of people trespassing in places like this one. However, literature from different disciplines, such as risk perception (especially in high-risk activities), sociology and heritage studies can be used to help answer the research question. A deductive approach was thus adopted in relation to existing literature, notably to test theories about risk perception in high-risk taken activities. Indeed, the results of the research were compared with findings from the existing literature.

A second literature review was also conducted, specifically on the risks affecting cultural heritage sites. It allowed to exhaustively identify sources of risk as well as destructive mechanisms putting heritage sites in danger, and to then deduce which of those risks were specifically applying to the context of Paris quarries'.

Search engines like *Google Scholar* and *LUBsearch*[12] were used to find relevant articles and documents for both literature reviews. Reference lists of relevant literature were also examined in order to select further articles and books considered relevant to the subject.

3.3. Data analysis

3.3.1. Risk assessments

Risk assessments were used to analyse the data, as they provide *"an understanding of risks, their causes, consequences and their probabilities"* (ISO 31010, 2009:10). Two separated risk assessments were made: one with a visitor safety perspective and one focusing on risks affecting the heritage site, which corresponds to what is considered valuable to protect in this thesis. The choice of considering illegal visitors and the heritage as valuable to protect is a subjective choice made by the author, who acknowledges that everyone does not necessarily share the same values (Keeney, 1992). Those assessments were predominantly based on the data collected through the interviews with official stakeholders. Press articles were also included to create the risk assessment for visitors. Concerning the risk assessment for the heritage, it also took into consideration data collected through the second literature review described in the previous section, and observation based on videos and photos found in blogs.

[12] Lund University libraries shared search engine

Multiple risks were identified and analysed thanks to the collected data. Nevertheless, due to their nature, it was decided to adopt a qualitative rather than a semi-quantitative or quantitative approach to analyse risks' likelihoods and consequences. One drawback of this approach is that it gives fewer points of reference for readers and that the comparison of different risks is rather subjective.

3.3.2. Discourse analysis

Interviews with illegal as well as discourses found in blogs, videos and forums were analysed through discourse analysis in order to understand the perceptions and representations of different stakeholders. The term discourse analysis has been used in different academic disciplines, and thus encompasses a wide array of topics and research procedures (Lewis-Beck et al, 2004). Therefore, no consensus exists on how to apply discourse analysis in practice. In the present case, discourse analysis is used to study *"diverse discourses about the same object, which thus constitute different realities for different social groups"* (Herzog, 2016:69). Discourse is thus understood from a sociological standpoint: it implies that different discourses will be analysed with neutrality in order not to favour a stakeholder's discourse over another. One consequence of choosing this approach is that both contemporary heritage and historical heritage were taken into account in this research, without favouring one over the other.

In terms of data analysis, discourse analysis seems relevant for the research in the way that previous studies on risk perception showed that risk is socially constructed, meaning that different social spheres (such as authorities and the general public) have different logics to identify risks (Le Breton, 2012:44). Therefore, discourse analysis was used to compare official stakeholders' discourse with illegal visitors' one, as well as to explore eventual divergences among illegal visitors' discourses. More specifically, discourse contents between the two groups of stakeholders were analysed in order to identify any potential discrepancy regarding their risk identification (are the different stakeholders mentioning the same risks?). Within the illegal visitors' group, discourses were also analysed in order to identify possible risk perception biases, and to try to understand the underlying factors which explain the causes behind those risk perception biases.

3.4. Research limitation and obstacles

The present research focuses on risks affecting the heritage as well as people in the quarries. Quarries can also create risks at the surface which are not studied in the present research. The reason to exclude this aspect is twofold: first, those risks are well-known and taken into consideration by the authorities and thus limited compared to the risks affecting the heritage and the illegal visitors. Secondly, it was not possible to thoroughly include this aspect in the research due to time limitations.

The main limitation when conducting a case study is its lack of possible scientific generalisation (Zainal, 2007:2). One way to overstep this limitation is to adopt multiple cases instead of one single case study. Unfortunately, a single case study was realised in the present work due to the limited timeframe for the research project. Concerning the discourse analysis, the quality of the research results can be lessen if some relevant stakeholders are not identified or because of some identified stakeholders non-response (Barriball and While, 1994:328). It can lead to the non-exhaustively of the results (some groups who could have different point of views, perspectives, perceptions and experiences in or with the quarries might have been excluded). It was the case in this study, since some official stakeholders did not answer to the interviews' requests (see figure 2, column "interview"). They could have provided different discourses on the risks illegal visitors and the heritage is exposed to in the case of Paris. Moreover, most of illegal visitors were reached through snowballing samplings. Snowballing consists of having recommendations of people to contact through a first contact, which consequently increases progressively the network of respondents (Valentine, 2013:117). Even though the research has tried to take into consideration different profiles of illegal visitors, this technique to reach out illegal visitors lead to the possible under-representation of some Cataphiles who might have different point of views than the ones interviewed in this study. Finally, all interviewees, except from the heritage officer at the Catacombs Museum and the staff member at the direction for occupational health and safety risks (Paris Municipality) were male. The non-representation of women might have distorted the results, but it also reflects that urban exploration and 'Cataphilie' are *"a predominantly male hobby"* (Fulton 2017:193).

Every data collection method presents drawbacks. Concerning interviews, people often try to show a better image of themselves and are inclined towards deliberately omitting some information (Bourdieu et al, 1983). Oppensheim (1992) also noted that the motivation of respondents can have an effect on the quality of their answers. Considering that trespassing in Paris quarries is illegal, those aspects might have interfered in the quality of the collected data.

The tendency of not giving all the information might have been emphasised by the fact that I am not a Cataphile (and so I might have not been considered fully trustable). Blogs have similar drawbacks as they are *"representations of experience rather than objective or 'truthful' accounts"* (Hookway, Snee, 2017:381). It is especially difficult to verify the authenticity and trustworthiness of what is being said.

Finally, analysing qualitative data is proven difficult especially in the case of CDA since researchers are subjects to biased interpretation of data (Barriball and While, 1994:331). Studying perception remains a difficult task as researcher's values and biases need to avoid interacting with the analysis. The transcription of the interviews was read by an external person and discussed in order to limit this issue.

4. Literature Review

In this chapter, a literature review was conducted in order to identify previous researches conducted on topics relevant to the present research. The literature review is divided in three subchapters, which respectively focus on the motivations for trespassing in Paris quarries, the risk perceptive of this activity, and the risks affecting Paris quarries' heritage. It permitted to identify existing gaps in the literature in relation to the research question of the thesis, which were introduced in a fourth subchapter.

4.1. Motivations for trespassing in Paris quarries

Cataphiles have various motivations for visiting the quarries, which are similar to urban explorers' ones (Glowczewski, Matteudi 1983; LeBreton and Héas, 2007:346). The first and maybe most obvious motivation is the desire to explore or have an adventure (Zuckerman, 1994; Wilson, 2012:644). Wilson (2012:644) recalled that "*exploratory behaviour is an innate characteristic"* of animals and people. That is why urban exploration has sometimes been included in *adventure tourism* literature (Hudson, 2003; Lebreton, 2015:45). The second motivation is the uniqueness of the activity and the desire to do or see something that most people have not (Wilson, 2012:644, Peirazeau, 2015:59; Stones, 2016). In this regard, *urbex* is a form of tourism which is *'anti-tourist by its very nature'* (Robinson, 2015:160, Mott, Roberts, 2013:233). According to Dauphin (2015:17), those two motivations are the main motivation for going in Paris quarries. Other motivations have been identified like the desire to *"engage in a physical or sporting activity"* (Wilson, 2012:644). Lebreton et al (2008:217) highlighted that people are partly going in Paris quarries for the sake of challenging themselves, as they in a way conquer a dangerous and hostile place. According to Lebreton et al (2008:218), going in Paris quarries allowed Cataphiles to link a sport and cultural practice in a unique activity, all of which highlights a fourth motivation: learning about the cultural, historical or geological aspects of Paris quarries. On the same note, the architecture, as well as the aesthetics of decay and ruins has often been described as a motivation to visit such sites (Stones, 2016:304). Finally, a last motivation is to get out of the urban routine, and to voluntarily put a distance with institutions (Lebreton et al, 2008:218; Lebreton, Héas, 2007:348; Peirazeau, 2015:61; Stones, 2016:303). Wilson (202:644) also noted the social aspect of the activity, which is well illustrated in the context of Paris quarries with the regular organisation of parties (Dauphin 2015:18).

In the description of the aforementioned motivations, many words refer to a certain level of danger and risk-taking behaviour ('adventure', 'challenge', 'hostile place', etc). This aspect will be discussed in more detail in the following part.

4.2. Trespassing in Paris quarries: a risk perspective

4.2.1. A desired risk taking behaviour?

Urban exploration, and thus trespassing in Paris quarries is recognised as a dangerous activity since it takes place in non-secured areas (Fulton 2017:191; Lebreton et al 2008:215). It legitimates the illegality of the activity. According to Lyng (1990), risk-taking can be interpreted as a form of resistance to the characteristic alienation of modernity. While risks in everyday life decreased in our present society, risk leisure activities have substantially increased, with people *"more willing to take unenforced risks"* (Cater, 2006:318; Machlis, Rosa, 1990:162 ; Creyer et al 2003:239). As a consequence of the development of such activities the number of injuries and even deaths augmented (Creyer et al, 2003:240). Nevertheless, it is important to put these numbers into perspective and to focus on the relation between the number of hours spent on the activity and the number of accidents, rather than raw numbers of accidents (Corneloup, Soulé, 2002:51).

Risk has been first described as an attractive and essential component of urban exploration and even as something adding value to the experience (Machlis, Rosa, 1990:163; LeBreton, Héas, 2007:346; Creyer et al, 2003:240). According to this assumption, risks are not only taken into account but desired (Machlis and Rosa; 1990:162). However, Stones (2016:310) showed in a recent study that the *"majority of urban explorers are not comfortable taking significant risks".* In any case, urban explorers and Cataphiles seem to be aware of the risks they are taking, might they desire them or not. Yet, we can assume that they do engage in a risk assessment process (Stones, 2016:310).

4.2.2. Risk perception in high risk activities

When writing on risk management in outdoor activities, Corneloup and Soulé (2002:35) pointed out the relevance of studying risk perception in order to better understand such high-risk practices. In the literature, risk perception in high risk activities has been studied by different authors (Vredenburgh, Cohen, 1995; Creyer et al 2003; Wilson, 2012; Corneloup, Soulé, 2002; Cater, 2006:320). Five relevant risk perception issues can be identified:

- Public awareness is high due to the high media coverage of accidents in high risk activities (Cater, 2006:320).

- People are more considering the severity of injuries instead of their likelihood (Vredenburgh, Cohen, 1995:126)
- Non- and irregular participants perceive the likelihood of negative consequences to be greater than frequent participants (Creyer et al (2003:244)
- With experience, people tend to take greater and greater risk because "*the 'adrenaline rush' many risk takers initially enjoy is substantially diminished as experience is acquired"* (Creyer et al, 2003:245)
- Perceived danger is influenced by past experience (Vredenburgh, Cohen, 1995:126). However, Creyer et al (2003:243) found out that a higher level of experience lead to a lower level of perceived risk (and the other way around), while Corneloup and Soulé (2002:37) argued the contrary: a higher level of experience is associated with higher level of perceived risk or at least a better analysis of the real dangers of a situation. On the same note, Wilson (2012:645) argued that novices are more likely to put themselves in danger due to their lack of experience.

4.3. Paris quarries: a heritage in peril

In his definition of heritage sites, Harrison (2013) noticed that some sites are chosen and conserved by authorities and legislation while some "*practices that are represented using the language of heritage (...) are not recognized by official forms of legislation"* (Harrison 2013:15). Paris quarries fall into this latter form of heritage called *unofficial heritage* (Harrison, 2013:14). One of the reasons might be that the quarries are subterranean and thus remain a largely unknown and "invisible" site (Peirazeau, Gelez, 2017:25). Moreover, Peirazeau and Gelez (2017:26) suggested that the site was devalued because of the existence of the Catacombs Museum, which is considered representative enough of Paris quarries.

Nevertheless, the interest of urban explorers for heritage has been highlighted when motivations for activities like trespassing in Paris quarries were previously introduced. Peirazeau (2015:68) also found out that the heritage value of the quarries is often presented as a motivation for Cataphiles.

It translates a power relation in what is recognised (or not) as heritage sites. The value assessment of cultural heritage sites is often presented as scientific or objective one, but they in fact reflect architects, historians and anthropologists' judgements and are thus socially constructed (Turnpenny, 2004: 297; Meul, 2008:1053; Veschambre 2007). This aspect has been theorised by Smith (2006:6) through what she called Authorised Heritage Discourse (AHD), which is according to her *"a professional discourse that privileges expert values and knowledge*

about the past and its material manifestations". According to Turnpenny (2004:297), it shows a non-inclusive approach of cultural heritage which hinders "*the integration of subjective and non-expert community values"*.

Paris quarries are therefore excluded from heritage conservation processes because there is neither national legislation nor international conventions protecting it[13]. Non-recognition of Paris quarries' value by authorities is putting them in multiple threats. As a consequence, Cataphiles came together to maintain the quarries, standing apart from classical conservation institutions (Peirazeau, Gelez, 2017:9). Cataphiles clean spaces by collecting waste, notably through the organisation of events called *"cata-clean"* (Dauphin, 2015:18). It reflects a main urban exploration rule that urges to respect the site and leave it as it was found (Stones, 2016:302; Fulton 2017:194; Lebreton, 2015:47). Others actively restore the quarries, especially the places which are considered defiled by tags (Dauphin, 2015:18). However, Cataphiles seem to have different visions of what needs to be preserved: for instance, while tags are considered by some as vandalism, others consider them as a form of heritage (Peirazeau, 2015:302).

4.4. Conclusion of the literature review

In summary, the first part of the literature review permitted to establish a picture of the context and highlighted the various profiles and motivations of Cataphiles.

The second part summarised the main outcomes of researches focusing on high-risk activities similar to trespassing in Paris quarries. It permitted one to identify some findings in the literature regarding people's willingness to take risks, their risk awareness as well as potential risk perceptions bias that people might have. One thing that is currently missing in the literature is the actual risks that people are exposed to when trespassing in Paris quarries. Consequently, the present research will try to assess those risks.

Concerning heritage, the literature underlined that the non-recognition of the heritage value by official stakeholders as well as vandalism were putting the heritage at risk. In the following chapter, risks affecting the site will be further investigated in order to eventually identify other risks affecting the heritage site.

Based on this literature review, it is possible to formulate the assumption that heritagisation, or in this context the conversion of Paris quarries into "official heritage", might be the solution to protect people's lives and protect the heritage.

[13] For instance, the Hyogo Framework for Action and the Sendai Framework for Disaster Risk Reduction 2015–2030 integrated cultural heritage protection into disaster risk reduction framework, considering the vulnerability of cultural heritage to multiple threats such as natural disasters (Stanton-Geddes and Salman 2017).

5. Analysis and Results

This chapter presents the results of the study. In the first and second part, risks are assessed through the adoption of visitor safety approach and through a heritage perspective. In a third part, the official mitigation measures are presented while the fourth part presents the key results and analysis of illegal visitors' risk perception.

5.1. Risk assessment for the visitors safety

Assessing risks for the visitors in the case of Paris quarries is difficult because there is neither statistics nor official risk assessments available. Therefore, the following risk assessment was mostly based on interviews conducted with an IGC's member of staff and a staff member of the Direction for occupational health and safety risks of Paris Municipality[14]. The following risk assessment might therefore reflect the risk perception of the authorities.

5.1.1. Risk identification and analysis

Without any statistics available, the only public source of information is press articles. Press articles were found through a google search, by using the "news" section. Eight articles relaying accidents happening in Paris quarries were found, covering a period from 2011 to today (see Figure 4). It is nonetheless important to mention that many Cataphiles do not call emergency services unless it is very necessary due to the illegality of the activity. The interviewed IGC staff member assumed that *"we do not know half of the incidents happening in the quarries"*. For this reason, press articles were taken into account in the analysis to support findings from the interviews and to illustrate some risks, but they do not offer an exhaustive representation of the risks taken by Cataphiles and cannot be used to create any statistics related to risks in the quarries. Nevertheless, it is assumed that they illustrate the accidents with the most important consequences since people had to call emergency services in those eight cases.

To put the number of accidents into perspective, Peirazeau (2015:135) evaluated in the eighties (1980s) at 20,000 the number of "descents" in the quarries. This number has probably increased especially due to a higher media coverage of the quarries (Peirazeau, 2015:158). Overall, the number of accidents is therefore low compared to the number of visits.

[14] the Direction for occupational health and safety risks of Paris Municipality is in charge of assessing risks that people working at IGC might be exposed to, notably when going in the quarries for work-related purposes

Date of the event	Type of event	Consequence	Press article (source)
29-07-2011	Lost, during two days	*Unknown (probably minor)*	Le Monde (2011)
27-03-2015	Fall	*One person seriously injured ("between life and death")*	La Dépêche (2015)
11-09-2016	Heart attack	*One person died*	Le Parisien (2016a)
06-11-2016	Fall	*One person injured*	Le Parisien, (2016b)
11-03-2017	Fall	*One person seriously injured, one person injured*	Le Parisien (2017)
14-06-2017	Lost during 3 days	*The two persons were found tired and with a small hypothermia*	20 minutes (2017)
23-06-2018	Fall	*One person seriously injured (open fracture)*	France Info (2018)
11-02-2019	Fall	*One person seriously injured*	Le Parisien (2019)

Figure 4: Accidents related to the quarries in the media since 2011

Risks to Cataphiles when entering and going out of the quarries

Among the eight press articles found on the internet, five concern accidents related to ***falls***. By reading those articles, it seems that the majority of these accidents occurred when people tried to enter or leave the quarries. Paris quarries are situated approximately twenty meters under Paris. Since access is forbidden by law, there is no "official" entrances to the quarries and accesses are kept secrets by Cataphiles. Nevertheless, it is known that entrances are situated below some manhole covers (Figure 5). These manhole covers come out on pits which are equipped with ladders and more rarely with stone stairs (Figure 6). The ladder can be either twenty meter long or it can be a succession of approximately five meter long ladders, separated by intermediary platforms.

Figure 5: Access to the quarries through manhole covers (source: https://www.parismag.fr/)

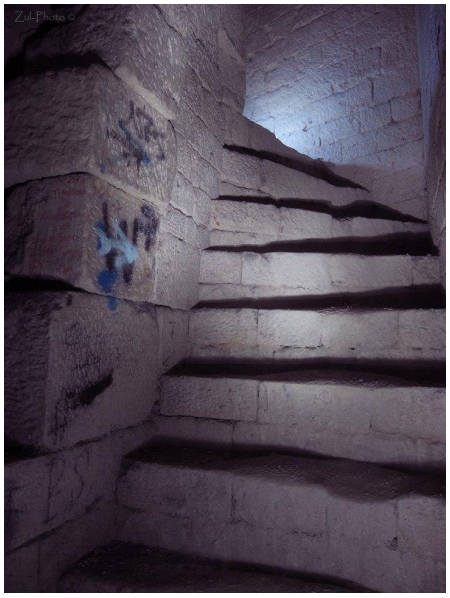

Figure 6: Access can rarely be made through staircases. Ladders are more common to access the quarries (Left picture source: https://www.parismag.fr/ ; Right picture credits: Zul, https://www.zul-photo.fr/zul-photo-accueil/sous-les-rues-catacombes/)

This difficult access explains the number of falls, which has been identified in this study as a first risk for Cataphiles. Approximately one reported accident related to falls occurs every year. This risk is accentuated by several factors. First of all, the interviewed IGC staff member explained that manhole covers are heavy (sometimes more than 100 kilograms). People have to close them after entering in the pit and open them from the inside when going out, which increase the risk to fall down from the ladder. Moreover, people can be stressed of getting caught by the police. Stress and hurry can increases the risk of falling down (Svanstrom, 1974:118). Furthermore, people usually spend a lot of time in the quarries (more than five hours) and go there during the night. They can be very tired and thus less careful when leaving the quarries. Finally, a last increasing factor is the high consumption of alcohol and even drugs in the quarries which can definitely lessen people's carefulness when going out of the quarries. According to the IGC, approximately two third of people have drugs with them when they are arrested in the quarries during weekends. Consequences of falls can include major injuries and even deaths (even though it has never happened in the case of the quarries). Added to that, small to serious injuries can also occur when opening or closing the manhole cover.

Down in the pit, people are either directly in the quarries if the pit was constructed and used at the time stones were extracted from the quarries, or in utility tunnels[15]. Access to the quarries from ***utility tunnels*** can represent a high danger depending on the type of cables which

[15] Utility tunnels carry lines such as electricity as well as communications utilities like fibre optics, cable television, and telephone cables.

are contained in the utility tunnels. For instance, Électricité de France (Electricity of France - EDF) has some utility tunnels with high voltage cables (25 000 volts) and the interviewed IGC staff member highlighted that *"apart from the risk of creating an electricity cut in a part of the city, people can be instantly carbonised if the cables break".* Therefore, while the likelihood of such an accident is very low, the consequences can be very high.

People often have to crawl into small and sometimes several meters long holes to join the quarries network, especially when entering by a utility tunnel (Figure 7). Those "holes" are called *"chatière"* ("cat flap") due to their narrowness. While no ***structure collapses*** causing injuries were found in press articles[16], this risk cannot be excluded since people digging *"chatières"* might destabilised the quarries fragile environment. As the interviewed IGC staff member explained:

> *"The risk of collapse mainly concerns people who unbalance the already fragile environment by digging chatières, but I have never heard about incidents of this kind. However, it is a risk that cannot be ruled out, it is true that we have examples of chatières dug under starting cave-ins which were filled with unstable backfill".*

The consequence of a collapse can vary a lot, from just getting trapped with minor injuries to death if a major collapse occurs.

Figure 7: Cataphiles sometimes use very narrow 'chatières' to get in (or out of) the quarries. (Credits: Zul, https://www.zul-photo.fr/zul-photo-accueil/sous-les-rues-catacombes/)

[16] The likelihood of a collapse has become low since the IGC started in 1777 consolidation works in the quarries.

Risks to Cataphiles in the quarries

Two articles relayed information about people who got lost in the quarries. ***Getting lost*** is easy due to the scale of the network (almost 300 kilometres) and the difficulty to find your way in it. It is assumed that Philibert Aspairt (*or Asper*) was the first person who get lost in the quarries, on the 3rd November, 1793. Aspairt died in the quarries and his body was found eleven years later, in 1804 (Duval, 2011). Taton (1973) also offered a testimony by relating his misadventure of getting lost in the quarries (although he was more fortunate than Aspairt and was rapidly found).

Getting lost can occur for several reasons:

- If people decide to go in the quarries without a map or with a low quality map[17].
- If people do not know the network very well. Even with a map, exits are not indicated in the quarries and can be hard to find.
- If people have an improper source of light since there is no lighting system in the quarries. Some people's unique source of light is their phone which means that if they run out of battery or if their phone gets broken, they will be in total darkness.

Apart from Philibert Aspairt, nobody has been reported dead after getting lost in the quarries. The two teenagers who got lost in 2017 were found *"tired and with a light hypothermia but in good health"* (20minutes, 2017). The consequences of getting lost are therefore low. However, the likelihood is probably higher than reflected by the press articles. According to the interviewed IGC staff member, those events are often not reported because other people visiting the quarries might help people who are lost, and both IGC staff members and the police are making sure that people they meet in the quarries know how to go out.

In addition to this risk, the IGC and the Direction for occupational health and safety risks of Paris Municipality identified a risk related to the ***unevenness of the terrain*****.** Indeed, the ceiling height as well as the ground are uneven and thus there is a risk of banging, slipping, and falling (Figure 8). The likelihood of this risk is high according to the Direction for occupational health and safety risks of Paris Municipality. In 2018, the only accident that they reported in the quarries was an IGC worker who banged into a ceiling and fell down due to the strong impact. While darkness in the quarries makes it difficult to identify ceilings height differences and thus probably accentuates the likelihood of banging in ceilings, slipping or falling down, none of those risks has ever been mentioned in any press articles. We can make the assumption

[17] There is a subsequent difference in terms of maps quality, with the best ones being the hardest to find (they are usually not available on the internet).

that the consequences are generally low and therefore people do not feel the need to call emergency services when an accident of this kind happens.

Figure 8: In the quarries, the ceiling height is uneven (Credits: Zul, https://www.zul-photo.fr/zul-photo-accueil/sous-les-rues-catacombes/)

The interviewed IGC staff member also pointed out that galleries can be flooded (Figure 9) and even though it does not present a particular danger for the Cataphiles as only slow onset ***floods*** occur, the combination of flooded areas and the presence of rats (Figure 10) created a risk linked to zoonotic diseases. The presence of rats developed due to the higher frequentation of the quarries by Cataphiles, who sometimes created galleries (*chatières*) from/to the sewage system in order to have an easier access to the quarries. Rats sustained because people often bring and eat food and sometimes do not collect their rubbish. The main risk of zoonotic diseases is ***leptospirosis*** which is spread by rats' urine and can be contracted by humans especially when being in contact with contaminated water (Monahan et al, 2009:708).

Figure 9: A flooded gallery (Credits: Zul, https://www.zul-photo.fr/zul-photo-accueil/sous-les-rues-catacombes/)

Figure 10: A rat in the quarries (Source: http://ktakafka.free.fr/)

In the region of Paris (Île-De-France), 76 people contracted leptospirosis in 2016 (See figure 11). However, *"the incidence of the disease is underestimated due to the absence of non-specific symptoms, and the lack of awareness among the medical community"* (Bourhy et al, 2016). Due to the difficult diagnosis, the consequences of leptospirosis are high with 5 to 20% of people dying from it in the world (Bourhy et al, 2016). Most of leptospirosis cases are due to the practice of outdoors activities such as kayaking, and it is unknown if leptospirosis cases have ever been diagnosed in the quarries as people would probably not mention contracted it in there due to the illegality of this activity.

Year	**2013**	**2014**	**2015**	**2016**
Number of cases	37	93	72	76

Figure 11: Number of cases of Leptospirosis per year in the whole region (Ile-de-France) Source: https://leptospirose-prevention.fr

The interviewed IGC staff member identified a risk linked to ***harmful or noxious gas emissions and lack of oxygen*** due to the bad ventilation of some part of the quarries. The likelihood of being injured by harmful gas and a lack of oxygen is however low because harmful gases are mostly found locally in the less frequented parts of the network, according to the interviewed IGC staff member. Moreover, people tend to move a lot in the quarries which reduce their exposure to this risk. The probability of a lack of oxygen can nevertheless be increased when people organised parties because of the high concentration of people at the same place. Consequences can be important since people can eventually pass out. Lubin et al (1995) also recorded ***high concentration of radon***[18] in some part of the quarries. Radon can create important health issues in the long-term such as lung cancer if people breathe large amounts of radon over a long time (Lubin et al, 1995). Nevertheless, the Direction for occupational health and safety risks of Paris Municipality evaluated the exposure of IGC staff members to radon being low considering the frequency of visits and the time spent in the quarries. However, some Cataphiles may be more exposed to this risk than IGC staff members.

Among the other identified risks, the interviewed IGC staff member was informed that some fights sometimes occur in the quarries, which he called ***"the social risks".*** While the truthfulness and the scope of this risk is unknown, the IGC and the police found some cartridges in the quarries. According to the interviewed IGC staff member, this risk was higher in the

[18] Radon is a naturally radioactive gas which is colorless, odorless and tasteless.

1980s but decreased over time. There has not been any recent reports of people injured in the quarries due to a fight.

Finally, a press article dated from 2016 informed that a person died in the quarries from a heart attack. ***Accidents and illnesses such as heart attacks*** are not related to the quarries and they can happen anywhere. However, this accident highlighted that consequences of this type of events can be aggravated by the fact that there is no signal in the quarries[19] (someone has to go out to call emergency services) and it can be hard for the emergency services to correctly localise the injured people due to the quarries environment. Also, quarries are very difficult to access for emergency services due to their narrowness and deepness (see figure 12). Actually, this factor exacerbates the consequences of multiple identified accidents such as falls, getting lost, structure collapse, harmful gas and social risks.

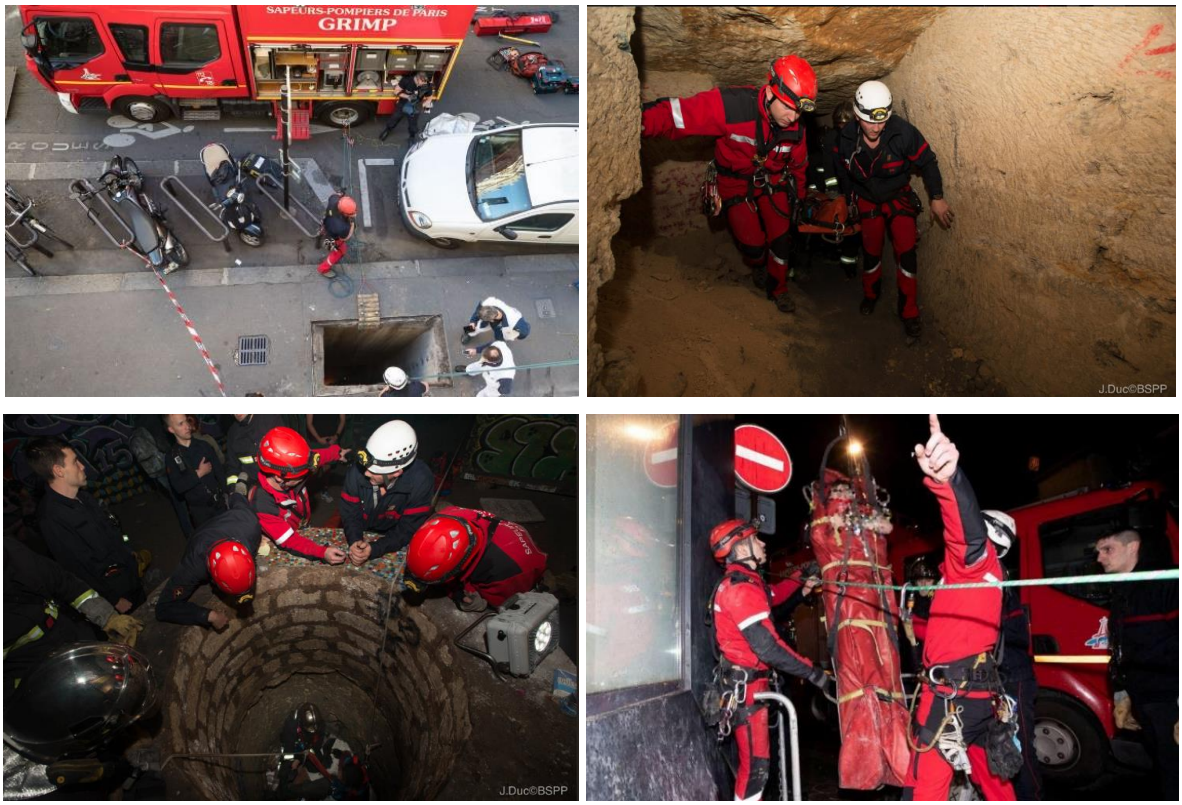

Figure 12: Intervention of emergencies services is difficult (Source: © BSPP)

[19] There is a no signal in the quarries, apart under some pits.

5.1.2. Risk evaluation and presentation

In order to summarise the findings of the risk identification and analysis, a risk matrix was created (See figure 13). The risk matrix allows to compare risks (ISO 31010; Coppola 2011:161). According to it, getting lost, falling as well as risks related to the unevenness of the terrain are the most important risks to Cataphiles in the context of Paris quarries. Nevertheless, high uncertainties remain due to the lack of official data. Moreover, risks were analysed in a qualitative manner and thus the risk matrix reflects more a subjective interpretation of the findings by the author than an objective presentation of the risks for the illegal visitors.

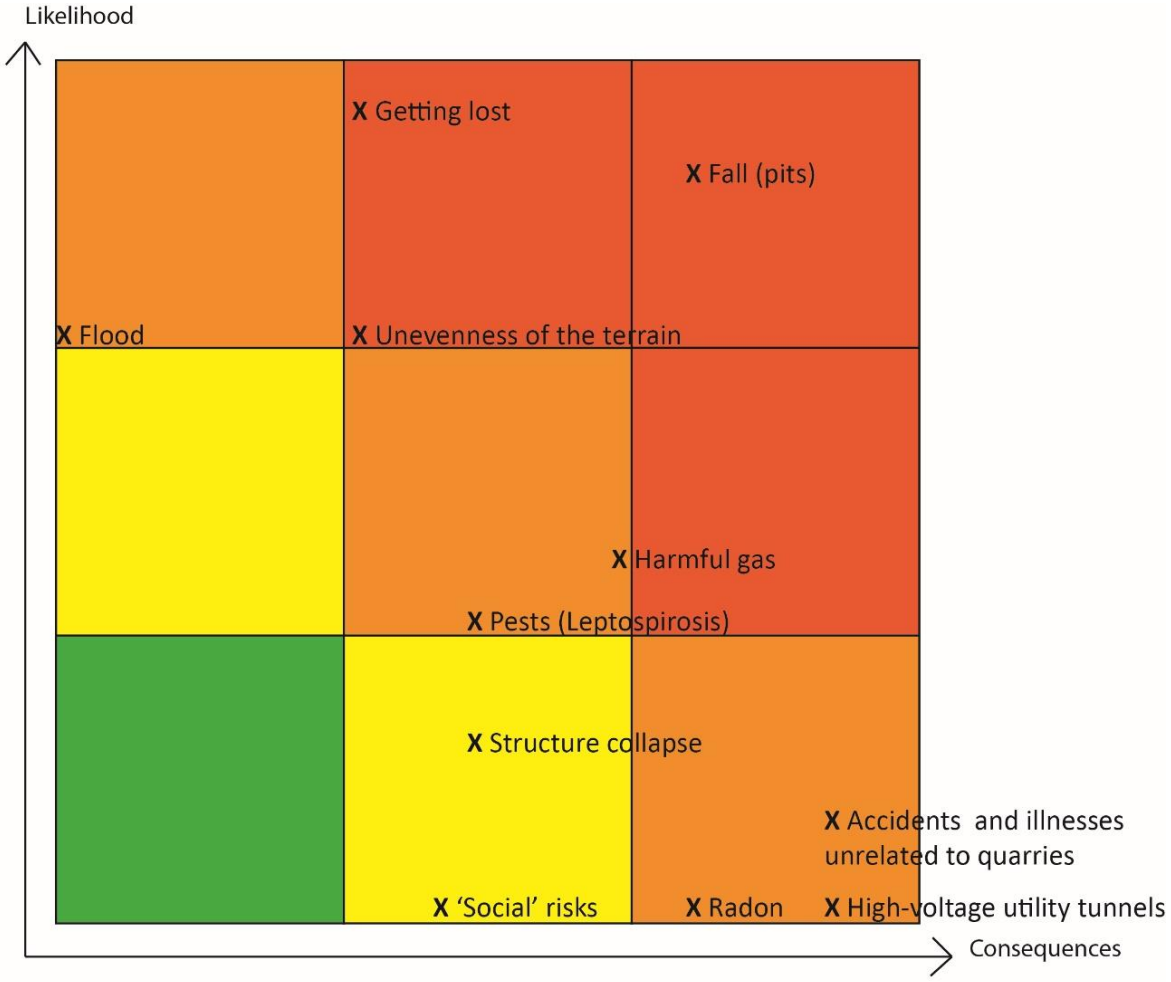

Figure 13: Risk matrix: Risks to the Cataphiles

5.2. Risk assessment for the heritage

Just like risks affecting Cataphiles, there is no risk assessment made for the heritage because Paris quarries are an *'unofficial heritage'*. Risks affecting heritage sites were identified through a literature review (see appendix 5) and further analysed thanks to interviews with the IGC and the heritage officer of the Catacombs museum[20]. Moreover, a field visit of the Capucins quarries[21] as well as photos and videos available on the internet helped to get some insights regarding the overall state of the quarries.

5.2.1. Risk identification and analysis

The analysis of the interviews with the IGC and the heritage officer of the Catacombs Museum helped to determine the three main sources of risks in the context of Paris quarries: some risks are caused by the natural environment of the quarries, by the authorities and by the Cataphiles. The three sources of risks were analysed without giving the priority to one source over another, as it was considered that all of them play a role in the degradation of the heritage.

Risks caused by the natural environment of the quarries

The quarries are made of limestone and thus are ***naturally subject to decay*** (Siegsmund et al, 2002). The heritage officer of the Catacombs Museum further explained that the high level of humidity which is a distinctive feature of the quarries' natural environment also accelerates the erosion of the quarries walls. It also contributes to colour fading and dissolution, and thus the deterioration of wall paintings (Stovel, 1998:74). ***Floods*** are also an inherent risk since quarries are located just above the water table, and water gauges are considered as heritage artefacts of the quarries (figure 14). Nevertheless, floods can sporadically affect some parts of the quarries and thus contribute to the limestone erosion and deterioration of wall paintings. In the long term, limestone erosion can lead to ***structure collapses***. While those risks are caused by natural processes, "*the response to prevent the risk they represent to cultural heritage is a human responsibility"* (ICOMOS, 2000). Therefore, both authorities and Cataphiles actions (and inactions) accelerate those natural processes and put the heritage at risk.

[20] Indeed, it was possible to put into perspective some risks affecting the museums with those affecting the quarries.
[21] Even though they are protected and valorised by an association called SEADACC

Figure 14: The Capucins fountain and its water gauge (Source: http://ruedeslumieres.morkitu.org)

Risks caused by Cataphiles

Cataphiles accelerate risks related to ongoing natural processes through multiple ways. First of all, by digging "*chatières"* they do not only put themselves at risk but also the heritage since a structure collapse would mean a direct loss of a part of the quarries (and thus of heritage). Cataphiles also accelerate the erosion of limestone and thus the erasing of historical inscriptions according to the interviewed IGC member:

"With their repeated passages in the quarries, or just by sitting on stone benches, people erase historical graffiti (...). You can also see it because the stone becomes more and more curved" (Interviewed IGC staff member).

This risk can therefore be assimilated to ***overcrowding***, even though the number of simultaneous visitors is rarely high except during weekends. Concerning the numerous visitors during weekends, it can lead to incorrect temperature and humidity and then accelerate natural deterioration by chemical reaction, and lead to weakening of structures and erosion of limestone (Sanchez-Moral, 2005:274). Overcrowding can also increase the likelihood related to ***accidents*** to the heritage, or the likelihood of ***vandalism*** or theft: as the IGC staff member declared during the interview, *"people are rarely alone when they do stupid things"*.

Vandalism is the most predominant risk for the quarries according to the heritage officer of the Catacombs Museum. As Wilson (2012:645) stated, *"a few recreational cavers have engaged in destructive activities such as painting graffiti in a cave, breaking speleothems, stealing mineral formations and artefacts".* For instance, the IGC noticed that some plates stating the current or former names of the streets at the surface are stolen, which constitutes a

direct loss for the heritage[22]. Moreover, graffiti are particularly criticised when they cover historical inscriptions or plates (see figure 15). However, the interviewed IGC staff member clarified that graffiti are controversial since they can be considered as a form of art depending on people sensitivity (see figure 16). Not only the historical structure and artefacts are subject to vandalism: many contemporary constructions, sculptures, frescos, wall paintings are fully or partially destroyed by others. The distinction between vandalism and accidents is hard to determine since the quarries are not monitored, and therefore it is impossible to know if the destructions were deliberately made or not. Interestingly, the interviewed IGC staff member noticed that some people try to clean walls from the graffiti. This action can be considered as a destruction of the contemporary heritage of the quarries, and contradictorily, it also participates in the degradation of the historical heritage by accelerating the erosion of walls and the erasure of historical inscriptions:

> *"Some people think that rubbing the walls of the quarries will give back their initial appearance, but by rubbing tags they also rub historical inscriptions and thus a part of the heritage is lost"* (Interviewed IGC staff member).

Finally, Cataphiles also cause risks linked to the ***use of inadequate equipment*** according to the interviewed IGC member of staff. He noticed that the use of candles by Cataphiles blackens the limestones walls[23] and that a lot of visitors do not collect their rubbish, which also creates a source of food for ***pests.*** It is therefore an important risk for the quarries, even though rats are the only invasive species which has been seen in the quarries and it do not represent a particular danger for the heritage.

Figure 15: A plate indicating a former street name covered by graffiti (Credits: Zul)

Figure 16: The limit between vandalism and art reflects people sensitivities… (Credits: Zul)

[22] The theft of plates with the names of the streets also mean a loss of information concerning the history of the city, since some plates indicate the former names of the streets.

[23] Blacken is a threat for the heritage itself, but as for the tagged galleries, some people tend to rub the blackened walls and thus historical inscriptions that they might not have seen.

Risks caused by authorities

The main role of IGC is to conduct consolidation works when the quarries present a risk for the surface. The interviewed IGC staff member explained that quarries are consolidating if they present a risk of collapsing or if the land-use on the surface is changing[24]. While consolidation works significantly limit the risk of structure collapse, ***injecting concrete*** in the part of the quarries which present a risk is the most used consolidation technique:

> *"We could build pillars instead, but using this type of method is complicated… And it is very difficult to intervene because there are not accesses everywhere (…) the IGC tries to preserve as much as possible the heritage. Nevertheless, when we have to choose between the heritage and risk [for the surface], we are obliged to give priority to risk prevention"* (Interviewed IGC staff member).

The use of this technique is also explained by its low cost compared to building pillars. Therefore, it reflects the lack of political interest and thus the lack of funds allocated to quarries conservation, which was already identified in the literature review. The ***lack of policy and legislation*** does not only lead to concrete injections in the quarries but also to an absence of conservation actions which directly contributes to the acceleration of the aforementioned natural degradation processes. It also highly affects the heritage since it gives free rein to vandalism: because of that, people stealing historical artefacts such as street name plates have no risk of being sued. Moreover, the lack of political interest particularly affects the heritage site as it leads to a ***lack of monitoring*** of cultural assets, with a poor documentation and nonexistence of any inventory of the heritage assets present in the quarries. The interviewed IGC staff member informed that this risk is however limited in the quarries because some researchers collect information or conduct researches about the quarries without any official authorisation to go in the quarries.

5.2.2. Risk evaluation and presentation

The following risk matrix summarises the key findings of the heritage risk analysis (Figure 17). Even though the risk evaluation is subject to many uncertainties, the lack of policies and legislations as well as vandalism have been identified as the most important risks for the heritage. The use of inappropriate equipment, as well as the lack monitoring and the changing land-use have also been assessed as major risks for the heritage.

[24] For instance, it is planned to build a new building and there are doubts if the quarry could support its weight.

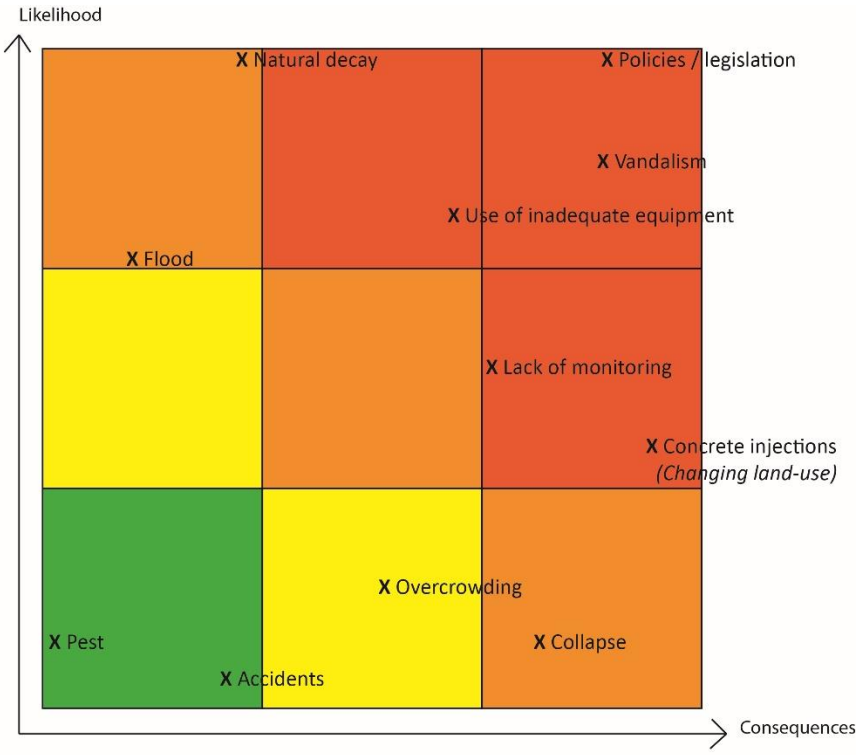

Figure 17: Risk matrix for the heritage

This risk matrix offers a representation of all the risks, but those risks are hard to compare. Indeed, some risks like the lack of monitoring and the lack of policies and legislations represent an indirect risk for the heritage while the risk of concrete injections or vandalism is a direct risk for the heritage. This difference between direct and indirect risk is well illustrated by figure 18, which offers an overview of the interconnection between the different identified risks.

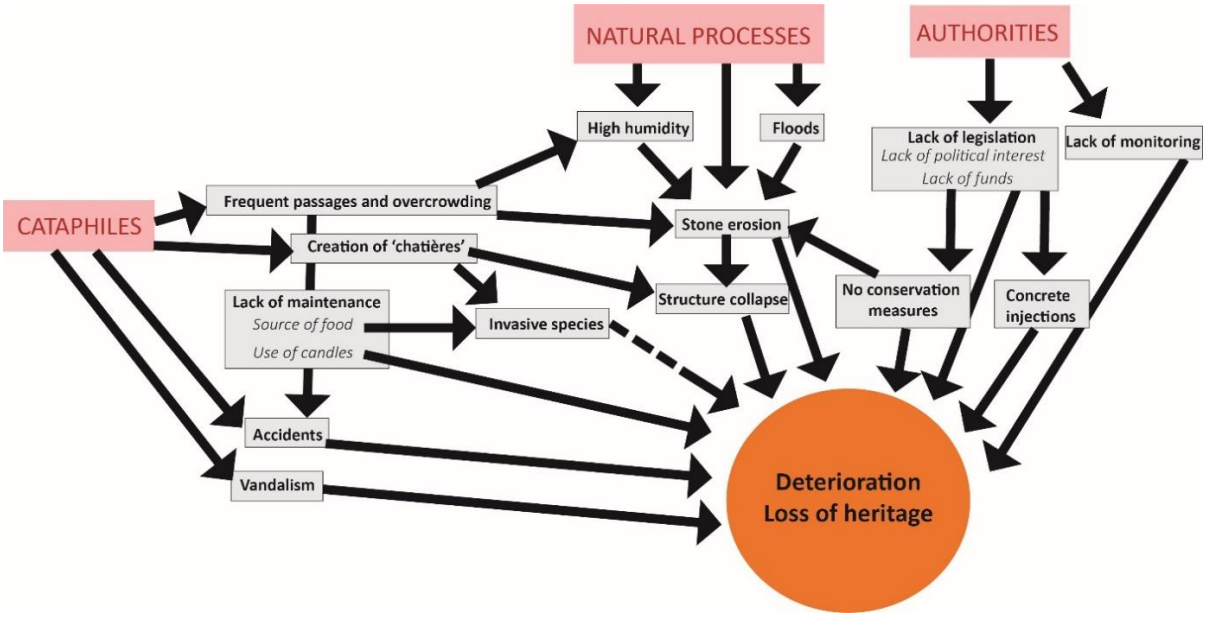

Figure 18: Summary of the risks for the heritage and their interrelations

5.3. Official risk mitigation measures

Currently, the only existing mitigation measure is the local bye-law from 1955 which forbids public to access the quarries and punishes them with a fine (from 38€ to 150€ approximately). It can be considered as a non-structural risk mitigation measure (Coppola, 2011:223)[25]. As the interviewed IGC staff member said:

> *"Officially, there is no safety question as no one is supposed to go in the quarries"* (Interviewed IGC staff member).

The IGC tries to prevent people from going in the quarries through structural measures[26] too, such as welding the manhole covers (which give access to the quarries), by pulling the upper rungs out of the ladders and by filling back in the *"chatières"* dug by Cataphiles. These mitigation measures can be assimilated to risk avoidance measures (Coppola, 2011:211). From a heritage perspective, risks for the heritage caused directly by the authorities and by natural processes are not reduced by any mitigation measures. The local bye-law is supposed to limit risks caused by the Cataphiles and especially avoid the risk of vandalism since acts of vandalism such as illegal graffiti in the public space are also punished by the French law. However, the bye-law does not seem to be enough to dissuade people from going in the quarries and is therefore inefficient to reduce both risks for people and the heritage. The interviewed IGC staff member explained that this ban was actually not motivated by security issues, but:

> *"This is an easy and understandable explanation for everyone (…). It is easier to prohibit access than to face legal problems. Actually, there are rumours that access to quarries was banned during the Algerian war because forbidden political meetings were taking place in the quarries"* (Interviewed IGC staff member).

The local bye-law seems to be more a legal protection for the IGC and the municipality in the event of an accident (as IGC would be able to disclaim all responsibility) than a veritable mitigation measure. This would explain why the ban to go in the quarries was not justified by a risk assessment when it was created in 1955. In this context, it can be assumed that illegal visitors rely on their own responsibility when going in the quarries. It highlights the necessity to gauge how illegal visitors feel about those risks, and especially their level of risk acceptance.

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[25] Non-structural mitigation measures *"involves a reduction in the likelihood or consequence of risk through modifications in human behaviour or natural processes, without requiring the use of engineered structures"* (Coppola 2011:223).

[26] Coppola (2011:213) defines *"Structural mitigation measures are those that involve or dictate the necessity for some form of construction, engineering, or other mechanical changes or improvements aimed at reducing hazard risk likelihood or consequence"*

5.4. Risk perception results

One objective of the thesis was to understand illegal visitors' risk awareness and risk perception. In order to do so, interviews were conducted with illegal visitors.

Taking risks was never mentioned as a motivation, nor as a reluctance for going in the quarries. Only visitor 2[27] mentioned the *"taste of adventure"* as a motivation which can be connected to a certain desired-risk behaviour and it was nonetheless not a predominant motivation for visiting the quarries. Moreover, visitor 2 was the only person mentioning "*the risk of getting caught by the cops"* and thus the illegality of the activity as a reluctant aspect for going in the quarries. It shows that the illegal aspect is not a preoccupation for most of the interviewed visitors and especially the more experienced ones:

> *"The fine, the fact that it is illegal? We don't give a shit [laughs]"* (Visitor 5)

Nevertheless, most of the interviewees answered that the ban was justified for safety reasons even though visitor 4 and 7 were not totally in agreement with it:

> *"Is it normal to forbid an activity because of its risks…? Well we do not stop people from skydiving, rock climbing or stuff like that"* (Visitor 4)

Therefore, it seems that people are aware of taking risks and even though the ban does not stop them from going in the quarries, it does not lower their risk perception. Their awareness was further demonstrated when questions concerning risks were asked:

> *"I never got injured, once I was stressed when getting down because it was a 20 meter long ladder without intermediary platforms so I had to be very careful. You always need to be careful, I acknowledge you can really injured yourself.* (Visitor 6).

Tiredness as well as alcohol consumption were acknowledged to be aggravating factors:

> *"I think the most dangerous aspect is that you get tired as you walk sometimes long distances or during a long time. (…) Half of people go down drunk and wasted, and then they have to go up… There has never been any fatal accident. We are lucky."* (Visitor 7)

[27] As a reminder, Visitor 2 was classified as a "tourist" which means he did not go often in the quarries and he was always guided by someone else.

However, only visitor 4 and 5 mentioned the difficulty of access for emergency services:

"There is a risk related to the fact that emergencies services cannot intervene rapidly" (Visitor 5)

[Responding to visitor 5] "According to me, it is actually the biggest risk" (Visitor 4)

Maybe this omission is related to the fact that when people were asked if they ever felt in danger, all interviewees answered that they had never been injured in the quarries. However, some of them answered that they felt in danger because they got lost, but the consequences were low since they found their way rapidly:

"It happened to me to get lost, but in suburban quarries which were not mapped. So in this situation, you are lost during two or three hours, but you still have a stock of light and water. So I never really panicked." (Visitor 1)

It contradicts with the research results presented by Vredenburgh and Cohen (1995:126) that is, people are more considering the severity of injuries instead of their likelihood. Indeed, according to the results of the risk assessment, the likelihood of getting lost is a lot higher than its consequence. Getting lost was probably the most referred risk in the interviews because people could relate to their own experience. Only visitor 2 (the 'tourist') did not mention this risk: as he was guided by someone else, his risk perception of getting lost must have been very low.

Most interviewed people identified the risk of falling from the ladder or being injured because of the unevenness of the terrain. Notably, two persons referred to a recent accident which happens in the quarries to illustrate this risk:

"I don't know if you saw it, recently a girl fell in a pit and broke... her femur I think. It's a friend of mine, so there are dangers, especially the moment you go in, the moment you go out." (Visitor 1)

As a consequence, the most important risks (identified with the risk assessment) seem to be well-known by Cataphiles and especially the experienced ones. Indeed, harmful gases were also mentioned by most of the people while leptospirosis was less mentioned but people

were usually mentioning that they were wearing waders[28] in the quarries. Flood, radon and high-voltage utility tunnels were never mentioned while social risks were only mentioned two times:

> *"Well if I was a girl I would be a lot more worried, like, of being raped because unfortunately it is easier there. I heard it happened in the 80s"* (Visitor 8)

One explanation of the high risk awareness is that Cataphiles seem to communicate a lot with each other's, about the risks and on other subjects, including the heritage and the threats to it. Cataphiles communicate in the quarries when they meet each other's, as well as on forums and Facebook groups. For instance, *'ckzone.org'* is a famous forum for Cataphiles where information concerning risks are sometimes shared:

> *"The gallery leading to 'Bélier', just after the concretion, is crossed by a crack on the ceiling. I went back recently, it seems to me that the ceiling was lowering a bit. Be careful going underneath, I do not know how long it will still hold."*[29]

When people were asked about how they feel about the risks, most of them answered that they were not worried about those risks because they felt aware of them as well as prepared:

> *"As for me, I always collect as many information as I can and then on site I do my maximum. If there is a problem… Well if you are well prepared and you know well what can happen, you should be able to deal with the situation"* (Visitor 3)

Even Visitor 2 (a 'tourist') did not seem to be particularly worried about the risks taken, which is in disagreement with the research of Creyer et al (2003:244)[30]:

> *"Risks are limited for people going in a reasonable way"* (Visitor 2)

This contradiction with the literature should be treated cautiously though, since only one irregular participant was interviewed and therefore it might not be representative of the perception of the whole group.

[28] Wearing waders is the main risk mitigation measure to avoid contracting leptospirosis, according to the interviewed staff member of the direction for occupational health and safety risks (Paris Municipality)
[29] Source: https://ckzone.org/showthread.php?tid=17399
[30] Creyer et al (2003:244) found that non and irregular participants perceive the likelihood of negative consequences to be greater than frequent participants

The aforementioned statements also show that visitors do not seem to be worried about the risks because they feel prepared to face them. It is true that mitigation measures are spontaneously taken by the interviewed visitors. Half of them never went alone in the quarries[31]. Almost everyone mentioned always telling someone staying at the surface about going down in the quarries, as well as communicating their expected return time. Moreover, everyone takes basic equipment such as maps, lights, food and water when going down:

> *"Concerning measures I took, I always tell people that I am going down, I always have maps with me, as well as food, water, headlamps"* (Visitor 6)

> *"The first time I went to the quarries, I went alone, without a map, without even a light. I met someone who told me "please promise me that you would not try to go there again alone without a map and a light. It is dangerous." He understood that I wanted to go there but I did not have the materials for it, so he sent me the map by email"* (Visitor 8)

Visitor 8's story particularly shows the community awareness concerning the necessity to take appropriate materials, and also illustrates a sort of kindliness and help among the Cataphiles.

Two persons even mentioned being equipped with gas sensors:

> *"I probably went one time in a gassed quarry, at least with a very low oxygen level like 12%, and there you feel that your brain is a little slow. Your whole body is slow, but your brain too. And there I said to myself ... well it's funny because in the heat of the moment you are so anesthetized by the lack of oxygen that you do not realize it; but as soon as it starts to get better, you tell yourself that you could have fainted in the back of the quarry and stayed there. (...) So after that we equipped ourselves, we bought detectors of gas and oxygen. But you know, all these dangers are known underground."* (Visitor 1)

[31] Visitor 3 and 7 go alone without any problem (the first one because he is used to do explorations on his own and the second because he is doing a lot of research work on the quarries and thus explained: *"I am not waiting for someone to come with me when I need to verify something or to collect information"),* Visitor 8 was mostly going alone at the beginning (*"I did not know anyone"*), finally visitor 4 explained that "*it happened that I went alone, but it was rarely the case. It is not good in terms of risks*".

This last statement also highlights that visitor 1 learnt from his own experience. It is in agreement with Corneloup and Soulé's (2002:37) argument identified in the literature[32].

If it seems that with experience Cataphiles better analyse the danger of a situation, the interviews also showed that they become more confident about those risks. For instance, visitor 1, 4 and 7 seem to have biases assimilated to the familiarity principle (Johnson and Levin, 2009):

> *"Quarries are chaotic, just like a garden... Well adding the fact that you can bang your head (…). Also, you get used to it and you become self-confident. That's how you start being less careful"* (Visitor 7)

As for visitor 8, he seems to have positive illusion biases:

> *"I am scared of getting lost, but apart from that, nothing. I am not scared of falling (…). Concerning accidents, you always tell yourself 'it is not going to happen to me"* (Visitor 8)

Those statements are in agreement with Creyer et al's (2003:243) research[33]. Since Corneloup and Soulé (2002) and Creyer et al (2003) findings are opposed, there is an ambiguity about what to conclude relatedly to the influence of experience on risk perception.

Overall, it seems that people accept risks they are taking and take full responsibility of their behaviour. Coppola explains that "*some risk reduction measures will result in one or more undesirable consequences. These secondary consequences may simply be the reduction in an enjoyed benefit that existed because of the hazard, or undesirable consequences may be expected to arise as a direct result of the mitigation measure*". (Coppola, 2011:212). This reason was actually perfectly demonstrated when people were asked about if they would like to see the implementation of some measures by the authorities to better protect the heritage:

> *"Every year, people organised an event to clean the quarries (…) I would like to see other measures to better protect the quarries, but not from the authorities (…) I would not like to have heritage expert meddling in as it would mean that the entrance would be charged (…) We would not have a space of freedom like we have right now"* (Visitor 1)

[32] Corneloup and Soulé's (2002:37) argument is: a higher level of experience is associated with higher level of perceived risk or at least a better analyse of the real dangers of a situation.

[33] Creyer et al's (2003:243) found that a higher level of experience lead to a lower level of perceived risk

However, for other interviewees, risk acceptance is not justified by their desire to have a 'space of freedom':

> *"I would like to see the quarries on the UNESCO World Heritage list and to have them accessible to everyone*" (Visitor 3).

Indeed, Visitor 3's personal objective is to disclose disused places which have according to him a cultural or historical interest[34]. Visitor 7 spent a lot of time in the quarries in order to study their history. In those two cases, risk acceptance seems to be motivated by their interest for the site itself. This reason is not excluded for the others interviewees, who all mentioned their interest for the history and the cultural aspects of the quarries.

Concerning heritage, interviewees considered different assets as heritage (historical or contemporary, and sometimes both). They referred to the three sources of risks (authorities, Cataphiles and natural processes) identified in the risk assessment (see chapter 5.2.). One finding of the interviews is that the risks for the heritage identified by the interviewees match with what they consider as being heritage assets:

> *"Among my motivations (…), seeing the beauty of some places, the artistic side, there is a gallery with all the frescos made by students at Ecole des Mines (…) the humidity and flood risk can really damage works of arts "* (Visitor 2)

> *"Regarding the taggers who cover old graffiti, they do not even realise the presence of this style of old graffiti, and when they know about it they say "they were old tags, everyone has always tagged underground…" which means that it does not matter to them."* (Visitor 7)

To summarise the main findings of the risk perception study, it appeared that Cataphiles have a very good knowledge of the risks they are exposed to when going to the quarries since they mention almost all the risks identified through the risk assessment made in chapter 5.1. Moreover, they take most of the time suitable measures to reduce the likelihood or consequences of those risks. It seems that risks are mostly identified through their personal experiences as well as thanks to communication among the community. Cataphiles have accepted to take those risks so that the quarries remain a site which is not controlled by

[34] Indeed, Visitor 3 is going to many other places in Europe and try to make them known through his YouTube channel.

authorities, or/and because their interest for the site makes it worth to take those risks. Moreover, some results contradict with the existing literature. For instance, the interviewed illegal visitors were not considering the severity of injuries instead of their likelihood when assessing risks. Interestingly, results related to the influence of experience on risk perception supported both Corneloup and Soulé (2002) and Creyer et al (2003) researches despite those two works being in opposition with each other's.

Concerning the heritage, the interviews findings attested the findings of the literature review concerning what is valued as heritage. One interesting finding is that risks for the heritage were identified by illegal visitors accordingly to what they perceive as being heritage (for instance, tags for those mindful of the historical heritage).

6. Discussion

This chapter summarises the main findings of the research in relation to the research question. The risk perception results are further discussed in relation to the formal risks assessments. Moreover, links between the visitor safety and heritage perspectives on risks are highlighted. Finally, limitations of the results are presented with suggestions for future studies.

6.1. Summary of findings

The research aims at investigating the risks to and with the quarries of Paris. Two 'formal' risk assessments and one interview-based data set were used to get an overall picture of what threatens and what is threatened by the quarries. Therefore, the research question *"what are the risks for the illegal visitors and for the heritage in the case of Paris quarries?"* can be separated in two sub-questions, *"what are the risks for the Paris quarries' heritage?"* and *"what are the risks for Paris quarries' illegal visitors?".*

The first sub-question, "*what are the risks for Paris quarries' heritage?"* was answered by meeting objective two: *"assessing the risks that quarries are exposed to, as well as understanding how those risks are perceived by the different stakeholders".* The lack of policy and legislation, as well as vandalism, were identified as the main risks affecting Paris quarries. Most importantly, it was found out that natural processes, authorities and illegal visitors were putting the heritage at threat. Both authorities and illegal visitors were identified as causing the most important degradation effects by increasing natural degradation processes. Moreover, a key finding regarding the risk perception study is that Cataphiles were referring to risks affecting what they recognised as *being* heritage assets. For instance, people mindful of history were mentioning tags while some people sympathetic to contemporary heritage were bringing up humidity since it can cause dissolution of paints (Stovel, 1998:74).

The second sub-question, *"what are the risks for Paris quarries' illegal visitors?"* was answered by meeting objective one: *"Analysing the risks for the illegal visitors while understanding their perception and awareness of the risks;".* 'Getting lost' and 'falling' were assessed as the most predominant risks taken by people trespassing in Paris quarries. It appears that illegal visitors have a very good knowledge of the risks they are exposed to, and take most of the time suitable measures to reduce the likelihood or consequences of those risks. One finding is that illegal visitors assess risks using their personal experiences and information communicated among the community. Moreover, two reasons for accepting risks were identified: some Cataphiles want the quarries to remain a site which is not controlled by authorities, and/or have a strong interest for the history or cultural aspects of the site, making it

worth to take risks. Taking risks was nonetheless not an explicit motivation for going in the quarries. Those findings will be further analysed and interpreted relatedly to the existing literature in the following section.

Finally, the third objective of this thesis was to *"discussing the benefits and challenges to adopt a dual approach of risk management (through the lens of visitor safety and of heritage protection).*". The benefits and challenges to link both heritage protection and visitor safety approaches will be further discussed in section 5.3.

6.2. Risk perception results in relation to formal risk assessments

In the literature review, it was argued that risk assessments made by authorities and experts were offering different results from risk perception based assessments (Renn, 1985; Slovic, 1999:697; Slovic, 2001:19; Corneloup, Soulé, 2002:33; Hansson, 2010:231; Yang, Nair, 2014:323; Vojinovic et al 2016:592-593). However, the results of this study showed the opposite, with illegal visitors having a knowledge of the existing risks comparable to authorities. It can be explained by the non-existence of any official risk assessment: authorities and illegal visitors might refer to the same sources, facts and heuristics when assessing risks in the quarries. Another explanation is that communication channels might have informally been established between the two groups. Some interviewees mentioned exchanging on the quarries with IGC staff members.

The results of the risk perception study also showed that recreational trespassing in Paris quarries was not a sensation-seeking or desired-risk taken activity, an argument which goes with Stones' (2016:310) findings in *urbex* and against older literature on the subject (Machlis, Rosa, 1990:163; LeBreton, Héas, 2007:346; Creyer et al, 2003:240). The *exploration* desire of the interviewed illegal visitors was more motivated by the desire to discover the whole quarries network than thrill. The results also showed that people were accepting taking risks because they considered that what they gained from trespassing was worth taking risks. Therefore, it can explain the very good awareness and knowledge on risks that illegal visitors have: taking risks is not a goal *per se* and illegal visitors would rather reduce them by taking appropriate measures. This certain willingness to understand and know the risks might differ in other risk activities such as skydiving, where sensation-seeking is probably a more central aim of the activity. Therefore, it might explain why Creyer et al's (2003:245) findings (With experience, people tend to take greater risk) does not apply to the context of Paris quarries.

Finally, it was found that despite an overall good risk awareness among illegal visitors, some discrepancies exist: the most experienced visitors are also the most prepared ones to face

risks (for instance by taking gas sensors). This result was in agreement with Corneloup and Soulé's findings (2002:37) *("a higher level of experience is associated with higher level of perceived risk or at least a better analyse of the real dangers of a situation.").* However, the results also showed the contrary: the most experienced people were the most likely to have risk bias, which is in agreement with Creyer et al's findings (a higher level of experience leads to a lower level of perceived risk). One explanation of this contradiction is linked to people's motivation to explore the whole network of quarries previously discussed. Indeed, with experience, illegal visitors are little by little "getting off the beaten tracks" and go in less frequented areas of the quarries. By doing so, they exposed themselves to new risks, such as risks related to harmful gases. Since going in those parts is a new experience, those visitors tend to be attentive to potential new risks which leads them to take into account and adopt some measures to face those new risks. What seems to be a contradiction in fact presents two distinct and complementary aspects: experienced visitors are better prepared and know better the risks related to the quarries because they have involuntarily exposed themselves to more risks than less frequent visitors, and at the same time, their risk perception of the most "common" risks decreases, especially due to familiarity bias.

6.3. Bridging the visitor safety and cultural heritage perspectives

Throughout this research on Paris quarries, both visitors and heritage have been identified as valuable to protect. If the risks were studied separately, the two risk assessments sometimes overlapped, showing that some links can be made between the risks to the quarries and with the quarries. In this respect, the creation of *chatières* by Cataphiles is an interesting example: their creation is motivated by the difficult access to the quarries and as a way to facilitate the entrance in the quarries. However, their creation can lead to structure collapses which were both identified as risks for the people and the heritage. They also facilitate the entrance of invasive species (notably rats) in the quarries and thus the spread of diseases such as leptospirosis. Figure 19 illustrates the numerous interrelations which exist between risks affecting the heritage and the visitors. While disaster risk reduction for the heritage and disaster risk reduction for visitor safety have so far been treated separately, the interrelations found in this research suggest that adopting a holistic approach seems relevant to determine solutions and mitigation measures that would avoid duplication of efforts or the creation of negative effects on one asset or the other.

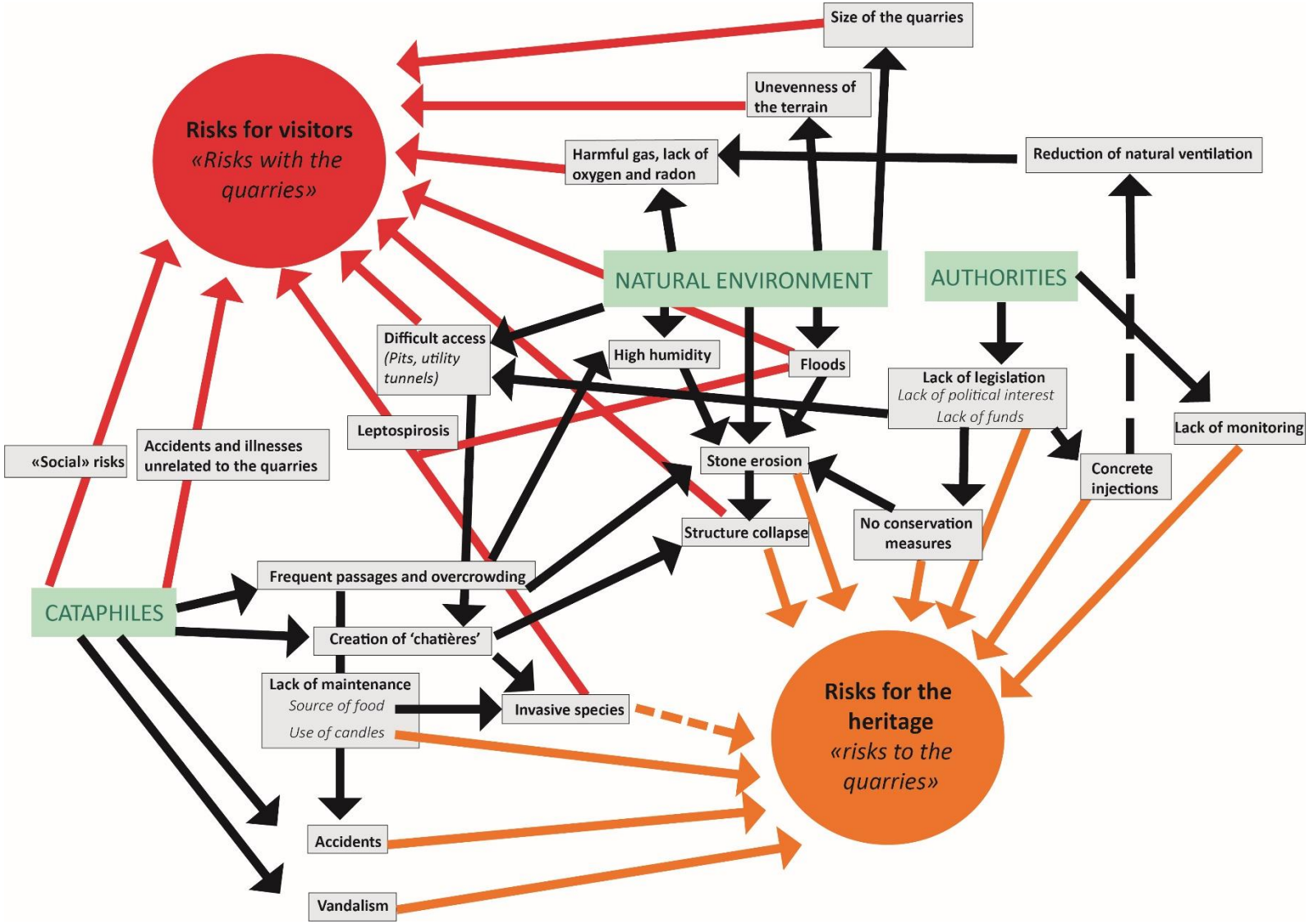

Figure 19: Causes of risks for visitors and for the heritage

Adopting a dual perspective was proven useful to formulate solutions that could be taken for the case of Paris quarries. Based on the literature review and on the two risk assessments, it first seems that the recognition of the quarries as a heritage site by the authorities could lead to securing the place so that people can visit safely, and to the implementation of conservation measures which would help better preserving the quarries. However, this solution is hard to implement. First, the costs induced by the site upgrade necessary to meet safety standards would be significant especially since the quarries are a subterranean and very wide network. Indeed, in order to reduce people's exposure to risks, structural mitigation measures[35] would have to be implemented such as creating a safe access to the quarries (like stairs) and a lighting system as well as providing visitors with appropriate equipment[36]. Moreover, the social acceptance of this measure is foreseen to be low given the results of the risk perception study. Finally, although heritagisation would surely decrease risks for visitors, the risks for the heritage would not necessarily be lessen, regardless the type of heritage. Indeed, taking the contemporary heritage protection perspective, heritagisation would "freeze" in time the heritage and prevent the production of new heritage assets. Thus, the quarries would not be a living heritage anymore. Concerning historical heritage assets, both the interviewed heritage officer of the Catacombs Museum and the IGC staff member highlighted the current problems in the museum related to its overcrowding[37] as well as the development of lichens and algae[38] (see figure 20). According to visitor 7, the recent developments[39] in the Catacombs Museum actually showed the limits of heritagisation, with profits becoming more important than good conservation. This argument can be illustrated by the fact that a competition was organised by the platform Airbnb to win a night in the Catacombs of Paris for Halloween (see Figure 21), a decision which sparked off controversy especially since Airbnb paid 350,000€ to privatise the Museum (20minutes, 2015). Finally, the recognition of the value of a site or its labelling do not insure its protection: in Meudon, a city situated in the suburbs of Paris, a quarry is at threat of disappearing even though

[35] Coppola (2011:213) defines *"Structural mitigation measures are those that involve or dictate the necessity for some form of construction, engineering, or other mechanical changes or improvements aimed at reducing hazard risk likelihood or consequence"*

[36] This equipment could be based on what IGC staff members used when going in the quarries as part of their job, see Appendix 6 for more details.

[37] *"Areas receiving visits are exposed to intense modifications both because of visitors and conditioning of the galleries for visits (i.e., lamps, ventilation, openings to the exterior, doors and panels, etc.)".* (Sanchez Moral et al, 2005:261)

[38] The development of algae and lichens is due to an inappropriate lighting system, combined with the inherent humidity of the quarries which altogether permitted photosynthesis to take place. Those 'invasive species' notably accelerate limestone erosion (Heritage officer of the Catacombs Museum interview).

[39] At the beginning, the museum was opened from 9:00 to 12:00 and 14:00 to 17:00 only two days per months and today it is opened every day of the week except Monday. Moreover, the length of the visit tour has been reduced (Clément, Thomas, 2016)

its artistic and natural value are protected by law[40] (Ar'site, 2019; Regional scientific committee for natural heritage of Region Île-de-France, 2018).

Alternative solutions such as heritagising the site similarly to the Capucins Quarries[41] would probably offer better results in terms of heritage conservation, but the social acceptance of this solution is expected to be low. Likewise, identifying and opening to public places presenting a high heritage value is a solution which might not please many Cataphiles, who claim that dividing the quarries network in small parts would denaturalised the place (Peirazeau, Gelez, 2017).

Figure 20: Development of invasive species because of the lighting system in the Catacombs Museum (Source: http://paris-bise-art.blogspot.com/2017/08/lagonie-des-catacombes.html)

Figure 21: Screenshot of Airbnb webpage about the possibility to win a night in Paris Catacombs for Halloween

Another solution could be to reinforce the current mitigation measures already in place. It is impossible to know if raising the fine or increasing the frequency of police rounds would actually discourage illegal visitors from going in the quarries. Concerning the structural measures taken by the IGC, such as closing Cataphiles' entrances, it could have the unwanted consequence of having illegal visitors taking greater risks to enter the quarries by digging new *chatières* for instance[42]. From the heritage perspective, this solution does not provide any

[40] Meudon quarries are protected by the law of the 2nd of May, 1930
[41] Capucins Quarries is only open to public on certain days per year in order to better preserve it
[42] As a reminder, the problem with digging chatières is that it might increase the risk of structure collapse.

improvement compared to the current situation. It also goes without saying that reinforcing the ban by structural and/or non-structural measures is not going to be accepted by the Cataphiles.

A 3D scan of the quarries could be a good solution from the heritage perspective. Indeed, it can be seen as a protection measure since it would provide a high fidelity replica of the quarries environment, and give access to this heritage to other people (who are not willing to go in the quarries). This solution can however been criticised: referring back to Mason (2008) definition of heritage, aesthetic values are an important part of heritage sites and do not only encompass visual aspects but all human senses. Therefore, one can argue that a 3D scan cannot be used to replace a heritage site itself. This argument further highlights that this solution is unlikely to reduce illegal visitors' frequentation and thus, to reduce risks *with* the quarries.

Another solution could consist in turning the quarries into an innovative laboratory of participatory conservation and art creation. It could be a great way to insure the protection of the living heritage while giving a chance to authorities to preserve the historical heritage of the quarries. For instance, some places in the quarries could be dedicated to art creation while agreeing to let the parts presenting historical aspects free of graffiti, frescos and sculptures. The form of this solution can be very different depending on the involvement of both parties: authorities could be in charge of the identified 'historical' zones while Cataphiles are responsible of the art creation parts. Community-based conservation could also be implemented, with heritage experts giving or sharing tools and knowledge to ensure a good protection of the historical heritage. Regarding visitors safety, the involvement of authorities would be required to ensure the creation of at least a safe access to the quarries.

In any case, the adoption of an inclusive heritage management process with all stakeholders would be necessary in order to potentially find an agreement suitable to both parties. Thus, this solution appears a bit idealistic given that going in the quarries is still an illegal act and it is thus hard to imagine both parties accepting to meet each other's. Moreover, Cataphiles do not have any "leaders" and one can wonder who could be chosen to represent them during such meetings. Furthermore, given the fact that Cataphiles are undertaking illegal activities, the legitimacy to find a solution or compromise which encompass their point of view can be questioned. Yet, based on Smith (2006)'s theory on authorised heritage discourse, it might be necessary and important to take this stakeholder into account since their sensitivity to the historical and contemporary heritage of the quarries might differ from official stakeholders' ones.

The discussion related to the solutions is summarised in figure 22.

Risks reduction… / Solution	for visitors	for historical heritage	for contemporary heritage	Social (Cataphiles) acceptance
Heritagisation (and similar alternatives)	+	-/+	-	-
3D scan of the quarries	-	-/+	-/+	+
access ban reinforcement	+	+	-	-
Laboratory of participative conservation and art creation	-/+	+	+	+

Figure 22: Examples of solutions in the case of Paris quarries, with consideration of visitors' safety and heritage protection

6.4. Limitation of the results and recommendations for future studies

The aim of this thesis was only exploratory and thus the results present several limitations. Even though the results permitted to answer the research question, one major limitation is the high uncertainties of the data, which lessen the quality of the results. Without any official sources of data available for both risks affecting visitors, the likelihoods and in a lesser extend the consequences of some risks were particularly hard to define. For instance, the boundary between voluntary (accidents) and involuntary (vandalism) acts of degradation caused by Cataphiles was hard to determine. Therefore, the obtained risk matrixes which help determining the most prevalent risks might be inaccurate and may reflect the subjective interpretation of the researcher. One limitation concerning the assessment of risks affecting heritage sites is the limited knowledge of the researcher in heritage conservation. Concerning the risk perception results, they are likely to be non-exhaustive due to the limited number of interviews conducted. Moreover, the author tried to adopt a holistic approach and to include in the risk assessments all risks that can affect illegal visitors or the heritage. Nevertheless, some risks might have been forgotten due to the complexity underlying the present case study. Further investigations are needed notably to understand if the risk perception findings discussed in section 5.2 can be applied to other cases (such as other high-risk activities or *urbex* cases), or if they are proper to Paris quarries' case.

Concerning the holistic approach of integrating both risks for the heritage and for people, this approach was proven useful in the case of Paris quarries but the generalisation of this approach might not appear to be relevant to other cases. A suggestion for further studies would be to explore to which extent adopting a similar approach can be applied to heritage sites: would it bring something in the case of official heritage? Could it bring solutions to other *'urbex'* sites?

7. Conclusion

The research aims at investigating the risks to and with the quarries of Paris. Two 'formal' risk assessments and one interview-based data set were used to get an overall picture of what threatens and what is threatened by the quarries. The main findings of this research are the followings:

- Concerning the risks for the heritage, both authorities and illegal visitors were identified as increasing natural degradation processes and thus as a risk to the quarries. Particularly, vandalism and the lack of legislation were identified as the main threats for the quarries. Moreover, a key finding regarding the risk perception study is that Cataphiles were referring to risks that affect what they recognised as *being* heritage assets. For instance, people mindful of history mentioned tags while some people sympathetic to contemporary heritage brought up humidity.
- Getting lost and falling were assessed as the most predominant risks taken by people trespassing in Paris quarries. The risk perception study showed that taking risks was not a motivation *per se* to go in the quarries, which might explain why many findings from the literature on high risk activities did not apply to the case.
- It also appeared that illegal visitors identified risks similarly to authorities, which can be explained by the non-existence of any official risk assessment and the potential communication channels existing between the two groups.
- Experienced visitors were better prepared and knew the risks better than infrequent visitors; yet, they were also more likely to have risk biases. What seems to be a contradiction at first is explained by the fact that experienced visitors go in less frequented areas of the quarries and they exposed themselves to more risks than less experienced visitors. They are thus more aware of the different risks in the quarries and at the same time, their risk perception of the most "common" risks decrease, especially due to familiarity bias.
- Analysing risks through both a visitor safety perspective and a heritage protection perspective has proven to be useful in the case of Paris quarries. Indeed, many interrelations were found between risks to and with the quarries. Moreover, this approach enabled the identification of solutions encompassing both a visitor safety perspective and a heritage protection approach.

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Appendices

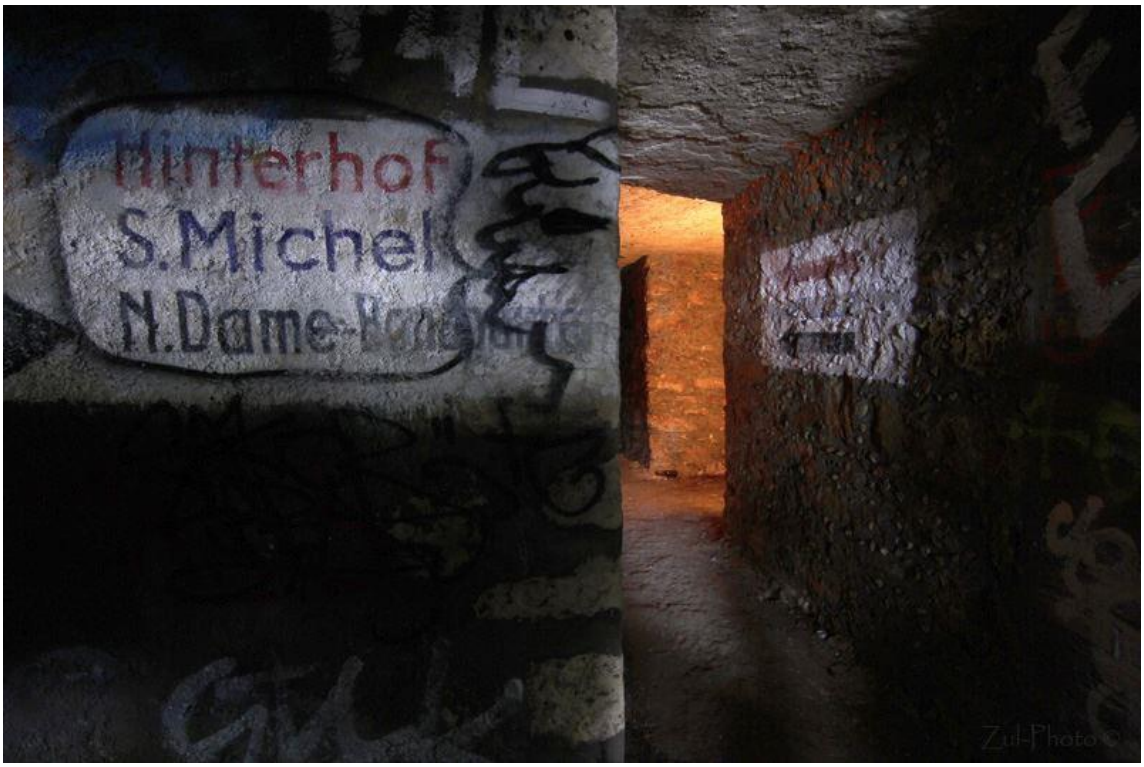
Appendix 1. Historical imprints in Paris quarries

This appendix compiles some main historical imprints visible in the illegal parts of the quarries. The pictures were taken by 'Zul'[43], who agreed that I use his work to illustrate my thesis. I would also like to thanks Gilles Thomas, who helped me to create an exhaustive yet concise compilation of the historical imprints of Paris quarries.

Old drawing of a fireman, dated from 1885-1895. It was unfortunately covered by graffiti.

Plate indicating a former street name. The street was indeed renamed "rue du Père-Corentin" in 1945.

[43] Link to his website: https://www.zul-photo.fr/zul-photo-accueil/sous-les-rues-catacombes/



The 'German bunker' was built during the German Occupatin (1943) under a highschool (Lycée Montaigne) near the Senate. The bunker was isolated from the rest of the network by concrete walls and security doors. The bunker was only used for passive defense.

Human remains can also be found in the illegal part of the quarries, even though the Catacombs Museum is best known for this aspect.

Cabinet of curiosities can be found in the quarries. Commonly referred as the ancestors of museums, cabinet of curiosities were in vogue in the 17th-18th centuries. Héricart de Thury (who also created the Catacombs Museum) had the idea to create specific cabinet of curiosities which displayed collections related to what could be found in the quarries. Most of them were displaying minerology artefacts as well as geological formations and were called Cabinet of mineralogy, like the one on the picture.

Philibert Aspairt got lost in the quarries in 1793, and his body was found 11 years later. He was buried on site and his gravestone can be seen in the 'Grand Réseau Sud' (main illegal quarries network visited by the Cataphiles).

Consolidation works in the quarries started in 1777. Every time an operation was taking place, IGC had to carved the number of the intervention (on the picture, intervention no.71), the initials of the the current Inspector General (here, G is for Guillemot, the first General Inspector from 1777 to 1807. At this time, royalty was still in place in France with Louis XVI as the king), and the year of the consolidation operation (on the picture, the year is 1778).

Fleur-de-lis (the symbol of French royalty) were carved approximately between 1780 and 185 (before the French Revolution) in the quarries. It indicates that there is a religious building at the surface. Only a few fleur-de-lis remain in the quarries. Indeed, on the 4th July 1793 (after the French Revolution), a decree ordered to erase them because they were the symbols of royalty.

After the French Revolution, the date of consolidation works were written following the French Republican calendar. "10R" means 10 years after the French Revolution.

At the time the quarries were used for exploitation, miners were creating column with stacks of stones between floor and ceiling in areas where a lot of mineral were extracted. This technique is called "piliers à bras" (Picture credits: Gilles Thomas)

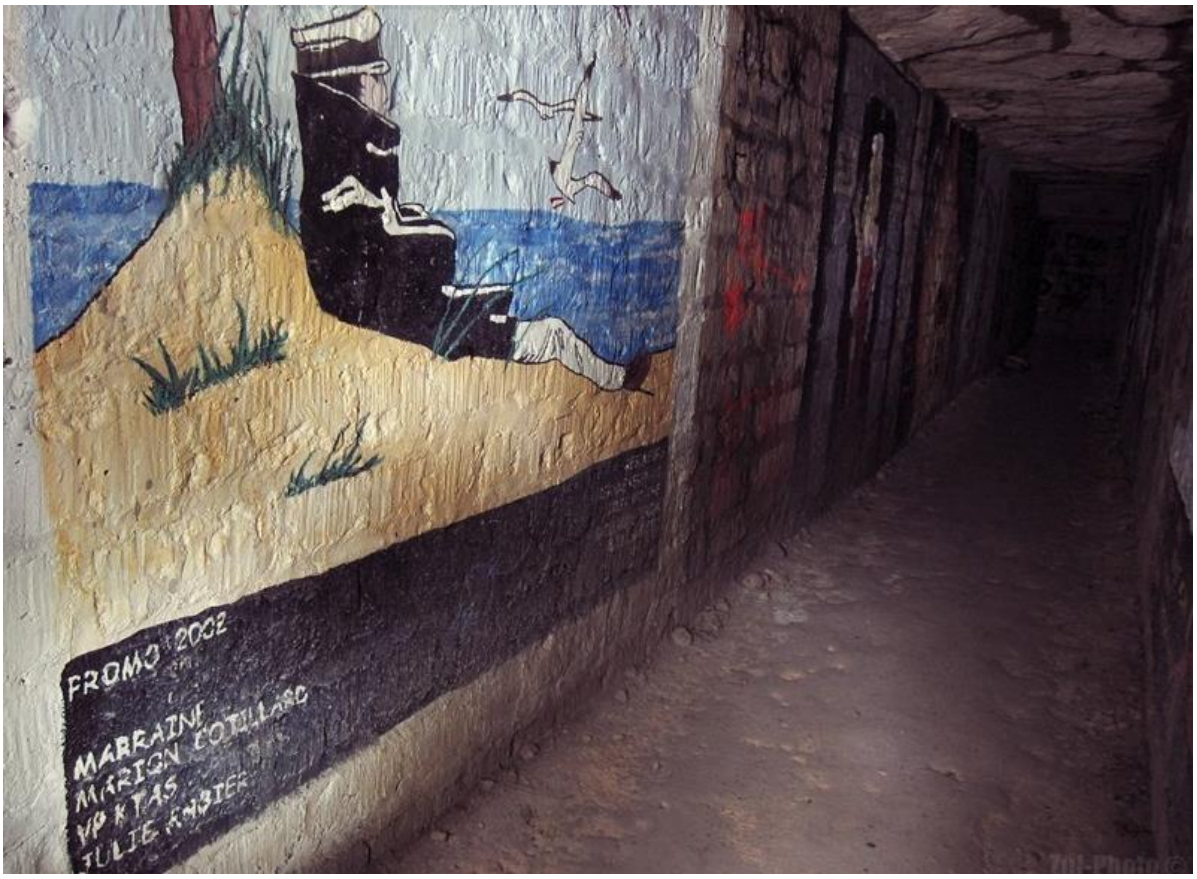
A second technique to prevent collapses at the time the quarries were still exploited is called "hagues et bourrages". This technique is explained on Wikipedia as follow:

> *"Instead of tunnelling into the exploitable mineral, miners would begin at a central point and extract stone progressively outwards; when they had mined to a point that left a wide area of the ceiling unsupported, they would erect a line of piliers à bras, continue their extraction beyond that line, then return to build a second parallel line of stone columns. The space along both lines of columns was then transformed into walls with stone blocks, or hagues, and the space between filled with packed rubble and other mineral detritus (or bourrage)".*

(Picture credits: Gilles Thomas)

Appendix 2. Contemporary imprints in Paris quarries

This appendix compiles some contemporary imprints in Paris quarries, based on the photographic work of Zul. Those picture might not reflect the current contemporary imprints visible in the quarries, because those are changing a lot and replaced by new ones.

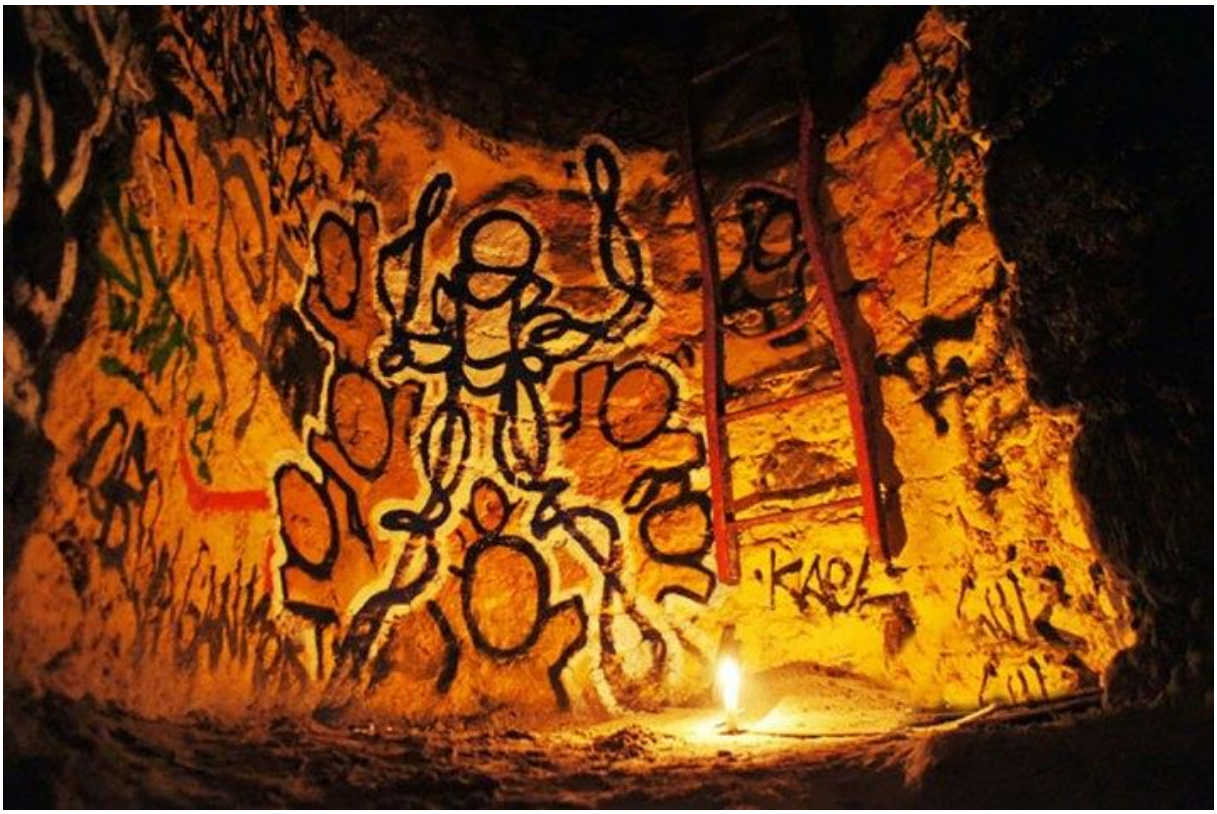


"Galerie des Promotions" (School year gallery) is a gallery with paintings made by each school year at Ecole des Mines.

A graffiti from 'Psyckoze', a famous French urban artist. Many graffiti like this one are visible in the quarries.

A graffiti from Jérôme Mesnager, a famous Frenc urban artist. On this picture is his most famous graffiti called "l'Homme Blanc" (the white man) and which can be found in many part of the world. He describes it as a 'symbol of light, force, and peace'[44].

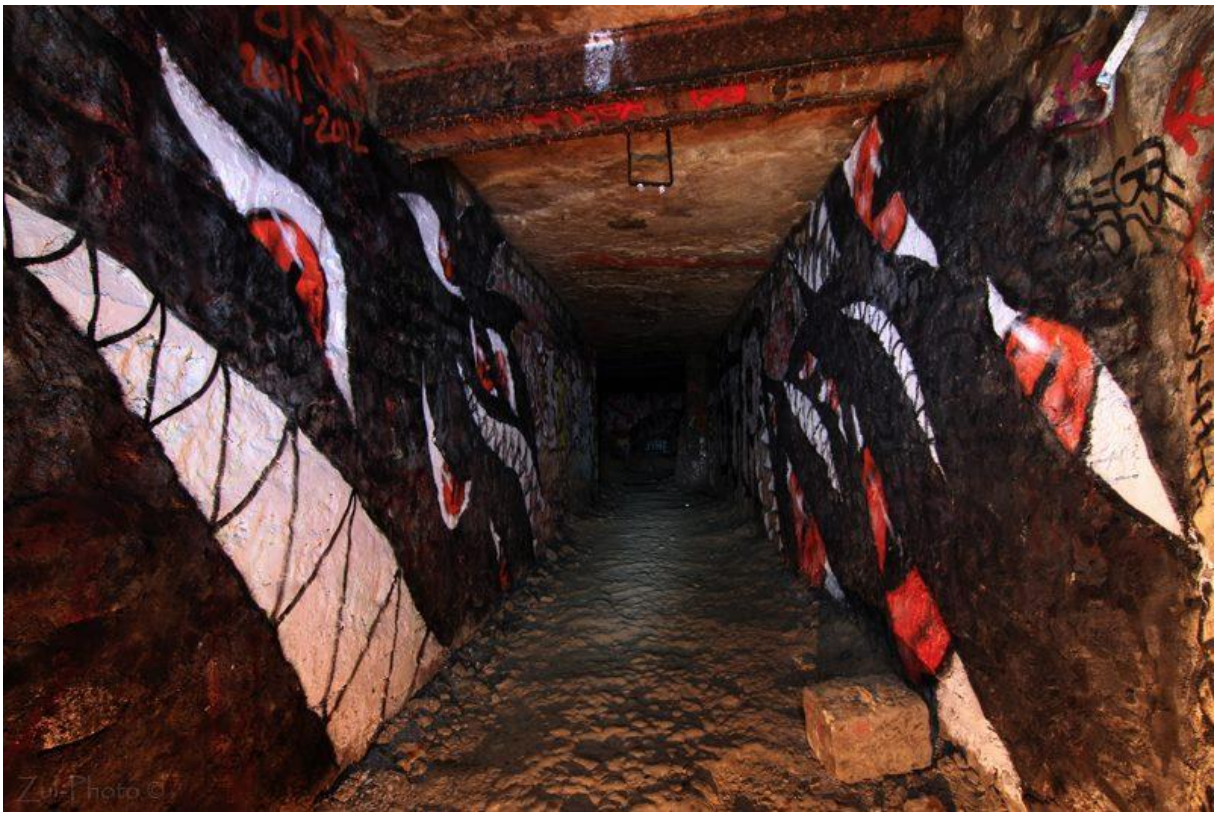
[44] Source: http://jeromemesnager.com/biographie/biographie-2/

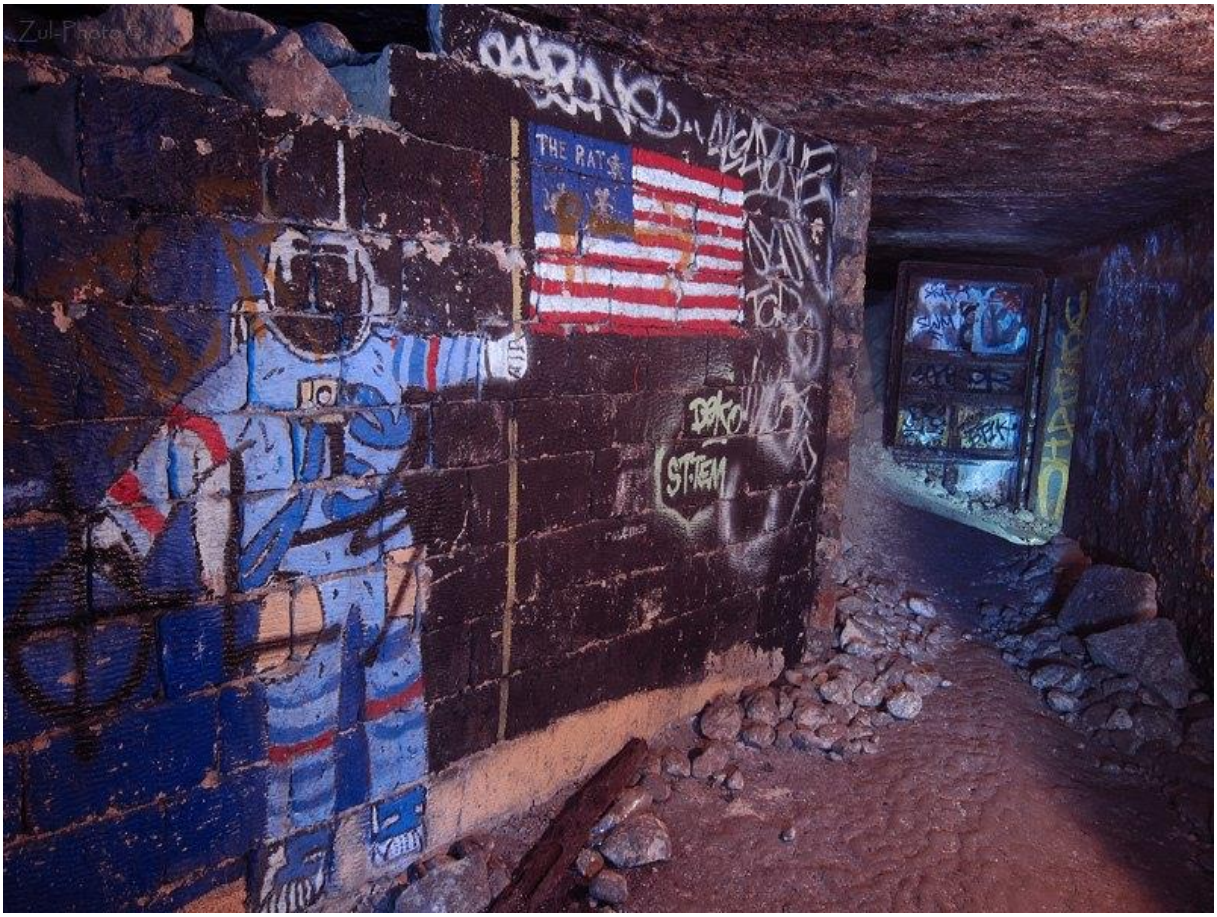


The small orange and faceless characters that you can see on this picture are called "Gouzou", and are made by the French artist Jace (Picture Credits: Jace, https://gouzou.net/gouzou/paris/).

This picture was taken in one of the biggest room of the quarries called "La plage" (the beach). The fresco is a reproduction of The Great Wave off Kanagawa (painted by Katsushika Hokusai 1829-1833)

There are many other sculptures, frescos and graffiti visible in the quarries:




THE RAT


Zul-Photo ©


Zul-Photo ©

Appendix 3. List of interviewees

Name	Role	Date of interview	Type of interview
Sylvie Robin	Heritage officer, Catacombs museum	01-03-2019	Face-to-face
Jules Querleux	Inspection Générale des Carrières (IGC)	22-03-2019	Face-to-face
Visitor 1	'Cataphile'	04-04-2019	By phone
Visitor 2	Mine Student	05-04-2019	By phone
Visitor 3	« Explorer »	06-04-2019	Instant messaging
Visitor 4 and 5	Mine Students	10-04-2019	Face-to-face
Visitor 6	Mine Student	11-04-2019	By phone
Visitor 7	Cataphile and historian specialised on Paris underground history	17-04-2019	Face-to-Face
Jennifer Brunel	Staff member at the direction for occupational health and safety risks, Paris Municipality	18-04-2019	Face-to-Face
Visitor 8	Cataphile	23-04-2019	Face-to-face

Appendix 4. Interview guideline

A4.1. Interview guideline addressed to the Quarries Inspection Office (IGC)

Preliminary questions

- Can I record this conversation?
- Can you tell me more about the work done by IGC in relation with the quarries of Paris

Risks related to people safety

- People working at IGC have to go to the quarries for their work. What measures are taken in order to assure the safety of workers?
- To which risks people going illegally in the Quarries are exposed to?
- Is the ban on going illegally in the quarries only due to safety reasons?

Risks for the heritage

- What is the heritage value of the quarries according to IGC and the authorities?
- To which risks this heritage site is exposed to?

A4.2. Interview guideline addressed to people visiting illegally the quarries

Preliminary questions

- Can I record this conversation?
- Can I have a name or a nickname, or do you prefer to stay anonymous?
- How old are you?

Visiting Paris' quarries: Frequency and motivation

- Do you often go to the catacombs/Paris quarries?
    - How often?
    - At what time of the day/the week/the year (depending on frequency)
    - How long do you stay each time (approximately)
- Do you go alone or with friends/ other "cataphiles"?
- What motivate you about going there?
    - What kind of activities are you doing in the catacombs?
- Are there any aspects making you reluctant to go in the catacombs?
- Do you visit other sites of this type (dark sites like Chernobyl, abandoned sites….). If yes, which one?
    - *In other words: would you describe yourself as an "urban explorer", or a "dark tourist", or simply as a "cataphile" or do you feel like you do not fit in any of those categories?*

Heritage value and risks for the heritage

- Do you have an interest for the history of the site or its geology?
- Do you consider the quarries being a cultural or natural heritage site?
    - Why do you say that?
- According to you, is the site well-preserved?
    - What elements make you say that? What do you consider as "signs" of degradation?
    - Are you trying to implement some measures, or would you like to see some measures being implemented to enhance the conservation of the site?

Public safety and dangers

- What do you think about the measure taken by the authorities to unauthorised the access to Paris' quarries?
- Have you ever felt in danger when you were exploring the quarries?
    - Because of what? In which particular context?
- Have you heard of any particular risks?
    - How do you feel about those risks? *Are you worried about them? Do you think they are part of the experience? Trying not to think about them?*
    - How prepared do you feel to face those risks?

Appendix 5. Risks affecting heritage sites

TYPE OF RISK	Identification in Paris quarries
1. NATURAL DETERIORATION PROCESSES	
1.1. Natural conditions - *Humidity* - *Cold and heat (temperature variation)* - *Wind pressure* *Soil characteristics (ground water, salt, etc)*	**Applicable**
1.2. Natural processes - *Natural decay of materials (rot, corrosion)* - *Erosion* *Weathering*	**Applicable**
2. NATURAL RISKS	
2.1. Hydro-meteorological events	
Wildfire	Non applicable
Floods, heavy precipitation	**Partially applicable *(floods)***
Windstorms	Non-applicable
Drought	Non-applicable
Heat waves and cold spells (extreme weather temperature)	Non-applicable
2.2. Geological events	
Earthquake	Non-applicable
Avalanches, land and mud slides and flows	**Partially applicable *(only structure collapse)***
Volcano eruption	Non-applicable
2.3. Biological events	
Pest and invasive species	**Applicable**
3. RISKS INDUCED BY HUMAN ACTIVITIES	
3.1. Act of violence - *Conflict* - *Terrorism* - *Vandalism*	**Applicable**
3.2. Changing land-use - *Urban transformation* - *Large development projects*	**Applicable**
3.3. Accidents - *Infrastructure failures, Industrial/nuclear accident (leak, spill, explosion, fire)* - *"Domestic" accident (incorrect handling, storage or transportation)*	**Applicable**
3.4. Tourism/overcrowding	**Applicable**

4. MANAGERIAL RISKS	
4.1. External managerial risks	
a) Policy related problems - *Conflicting authorities, problem of ownership and authorisation* - *Inappropriate strategies and priorities, inefficient bureaucracy* - *Lack of political interest* - *Lack of fund and investment*	**Applicable**
b) Legislation deficiencies - *Outdated definitions, lack of implementation measures, insufficient conservation standards* - *Unrealistic obligations*	**Applicable**
4.2. Intern managerial risks	
- *Inadequate team (due to a lack of training, limited knowledge)* - *Poor communication/ collaboration/ cooperation* - *Lack of human and financial resources*	Non-applicable
5. MAINTENANCE RELATED RISKS	
5.1. Inadequate equipment/ poor quality control of the infrastructures and equipment (lack of maintenance) *(e.g. lights, air-conditioning, source of food and nesting materials, faulty electrical installations or equipment)*	**Applicable**
5.2. Lack of monitoring of the cultural assets *lack of inventory, poor documentation or identification, hardware and software obsolescence*	**Applicable**
5.3. Inappropriate conservation/restoration practices - *Interventionism (urge to act without proper knowledge base)* - *Lack of understanding of the context*	Non-applicable

Adapted from Fafet and Mulolli Zajmi, 2019. Based on Galan, Aparicio, 2013 ; ICOMOS, 2000 ; Paolini et al, 2012 ; Pedersoli et al, 2016 ; Scalet et al, 2014 ; Sabbioni et al, 2009 ; Sugio, 2015 ; Stovel, 1998 ; Tarragüel, 2011

Appendix 6. Mitigations measures taken by IGC staff members

Structural mitigation measures:

- A specific outfit which includes gloves, a helmet with a chinstrap and waders (Wearing waders limit the exposure to water contaminated by Leptospirosis).
- Also, to limit fall risk, IGC staff members also have a descent control device, harnesses and ropes.
- Several printed maps
- At least two headlamps per person if a lighting system is not created.
- Gas sensors capable to detect explosive gas, carbon monoxide, lack of oxygen and hydrogen sulphide.

Non-structural mitigation measures:

- Being at least three in the quarries (so that if a person is injured one can stay with this person while the other person can go outside to call emergency services).
- The group should not be only constituted of people who do not know well the network
- For every intervention in the quarries, a colleague staying at the surface should be warned about the itinerary as well as the expected hour for coming back from the quarries.