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Evaluating the potential of zoos in reconnecting people with nature and conservation issues

Agathe Colléony

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atmosphere of our office would not have been the same without Julie and her (repeated) phone calls (no offense). I am glad to have shared my office with such a kind person, who will soon be my neighbor! Fanny and Baptiste were also very nice persons who provided me good advices when needed. Although Alan left the lab a few months ago, his jokes still resonate in the office. Minh-Xuan took his desk as soon as Alan left it (yes, it's a bit the jungle law for office places in the lab). I would like to thank Minh-Xuan for being so nice and supportive, even if he made me feel incompetent taking care at plants. Although we do not see Roman that often, his "nice" posters of cats remind us about his presence. Now that Hortense has left the lab, I can still discuss about horses with Flavie, so kind and supportive as well. Her recent adventures with her students brightened our working days, although I'm not sure she appreciated it that much. Caro does not really share our office, but she is pretty close. I would like to thank Caro for her kindness, infectious laugh, and for our future climbing sessions together.

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Abstract

With the on-going biodiversity crisis, growing urban lifestyles decrease opportunities to experience nature. However, an intimate relationship with nature has various benefits, for individual well-being, health or attention restoration, but also for environmental issues. Much research effort explored the extent to which people feel being part of the natural world, and thus focused more recently on the importance of reconnecting people – especially urban dwellers – with nature and conservation issues, through experiences of nature. In this work, we investigated whether zoos could participate in such reconnection.

We used an interdisciplinary approach, with concepts and methods from conservation biology, anthropology, social and conservation psychology, psychoacoustics, and ecological economics. We first explored whether zoos were considered as natural places. Then, we looked more closely at people's perception of nature at the zoo, from both visual and auditory perspectives. Comparative analysis between zoo visitors and urban park users allowed us investigate the impact of the zoo visit on sense of connection to nature and conservation attitudes. Finally, we focused on pro-conservation behaviors at the zoo through the analysis of animal choice and amount of donations of participants to an animal adoption program at the zoo.

This work demonstrates that although the zoo is considered and used as a natural place, it does not affect sense of connection to nature. However, compared to a visit to an urban green park, the zoo visit has the potential to raise conservation attitudes, through connectedness to nature. Additionally, despite an emphasis on captive, exotic species at the zoo, visitors also seemed to perceive urban wildlife. Nevertheless, unlike conservation attitudes, the contribution of the zoo in enhancing pro-conservation behaviors remains doubtful. To conclude, this PhD project highlighted that in the process of reconnecting people to nature and conservation issues, zoos undoubtedly provide one type of experience of nature to urban dwellers, that should be considered along with other types of experiences of nature, e.g. woodlands, especially because zoos are institutions that target a very large and diverse part of the population, worldwide.

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Foreword

To introduce my thesis, I believe that a short statement on what led me to this research project is necessary, to describe my position toward zoos. Indeed, everyone cannot help but be influenced by their beliefs, which is why I think it is important to describe my own. It thus implies that I might be more biased than the average person. However, as I will explain below, I tried to remain as neutral as possible, especially when interacting with survey respondents, and I cannot deny that my beliefs on zoos have evolved and changed during the past three years.

Although I have always wanted to pursue in an academic research career, my interests have evolved over my education. Indeed, I first studied biology and ecology of organisms, to pursue in a Master's degree in ethology, with a particular interest in animal social behaviors. However, the research placement I did in UK on human cooperative behaviors introduced me to the psychology research field. This year of education and research project made me realize the extraordinary complexity of human behaviors, and experience the pleasant feeling of the better understanding of the behavior of our own species. Nevertheless, my strong interest for animals and nature in general remained present, which is why I decided to strengthen my skills in the field of conservation biology with a second Master's degree. This gave me the opportunity to run field studies in remote places (i.e. National parks in Africa and Mexico) on conservation projects. In addition to improving my knowledge and skills on the topic, it made me face the reality of some conservation issues, particularly with local populations, which aroused my interest for the human dimension of conservation biology.

These field opportunities also gave me the chance to observe and closely encounter exotic animals in the wild: these moments were magic, and even if some were scary experiences (e.g. walking in the savanna bush and realizing that a python is hidden one meter aside, or trying to keep my balance when walking on the top of a fence separating two ponds full of crocodiles looking at you with their yellow shining eyes at dark), I believe that I will remember them during all my life. My perception of captivity therefore is probably different from that of the lay public. I think that since I experienced these encounters in the wild, I am less awed by the animals kept in captivity, like in zoos. To be more precise, I will probably admire the animal, but his condition will lower the feeling of wonder. I think that the intensity of the emotional reaction toward the caged animal will be too low compared to what I experienced with similar animals in the wild, and that this could prevent me from having the memorable experience that such animal encounter should provide. I will indeed refer to the

elements of the animal encounter that make the experience memorable in Chapter 2, related to the importance of natural sounds in the feeling of immersion in zoos.

Nevertheless, I do not have a clear position toward zoos, either positive or negative. I do not like captivity, but I am aware about the importance of conservation breeding programs in zoos maintaining genetic diversity. Moreover, even if zoos are used as recreational places, I believe that most visitors will exit a zoo with at least some more information, which they may not have looked for or realized they acquired. Indeed, we know that although most zoo visitors do not read information panels, zoos allow many people to encounter animals they have only seen through screens (television or internet) or books, and that such multisensory experiences are an important way to sensitize people about animals and the need to preserve them. Indeed, being aware of an issue does not necessary implies taking action toward this issue. For example, knowing that one species of primate among others is endangered, compared to closely encountering this species and having the chance maybe to share eye contact with this animal in a zoo, may have very different consequences for the person's commitment to preserve this species. The cognitive component is therefore not sufficient, and to my opinion, the affective matters as much, if not more.

However, my beliefs have of course evolved during the past three years, especially when interacting with zoo visitors. I have mostly grown up in rural environments, and my parents used to take us hiking in the mountains every year, so when some zoo visitors told me that the zoo was a real nature experience for them, I was first astonished by such discourse. To me, even if the zoo displays animals and natural environment, this natural environment is indeed artificially recreated and managed, so I hardly find the zoo visit as a nature experience. Nevertheless, I progressively realized that it largely depends on the reference point people have, the nature experiences they had during childhood, and the nature they currently have access to. So now, I can understand why people living in very urbanized environments may consider zoos as natural environments, because of a lower access to natural environments in general.

The interviews I conducted obliged me to adopt a neutral position, to make people comfortable enough to share their real thoughts with me, even if I did not agree with them. I even tried to show agreement, to make them even more comfortable. Of course, I will never know whether they told me the truth or not, but at least the exercise put me in a better position to understand their point of view. This was however not easy, since I have never conducted interviews before, because of my ecology and biology background. I had only approached psychology, through questionnaires, and never been familiar with more anthropological methods, as qualitative data and analysis. However, I received intensive training and help from Armony Piron, a former anthropology PhD student. I indeed learned how to approach people at the zoo and make them confident enough to share a

moment with me, and express their feelings and impressions. Additionally, and perhaps more importantly, she taught me many subtleties that could facilitate the process of the interviews, like putting yourself in an ignorant position, because otherwise the interviewee could be afraid of getting wrong or could simply ask for more information instead of expressing his/her own beliefs and sought. She also trained me on qualitative data analysis, and more precisely on how to analyze the content of the interviews as objectively as possible, but remaining aware that my personal beliefs may impact my interpretations of the discourse. Similarly, because I come from a biology background and may lack theoretical background on psychology, I participated in an international workshop on environmental psychology (STEP3). This experience therefore helped me better understand the concepts and methods used in environmental psychology, especially through the realization of an entire research project during the workshop with other PhD students in related topics.

This PhD project, mostly based on conservation psychology, aimed to be interdisciplinary, by mobilizing conservation biology, psychology and anthropology methods. Indeed, I received intensive complementary supervision from all my PhD directors: the regular interactions I had with Susan Clayton, one of the pioneers of the *Conservation psychology* research field, through skype meeting and visits in the US or Paris gave me the opportunity to benefit from her intensive knowledge and experience on my research topic. Additionally, being supervised by Anne-Caroline Prévot allowed me to better contextualize the project regarding biodiversity conservation; more importantly, her on-going research interest in social-ecological systems, and more precisely human experiences of nature, probably also helped me move from a biological background to social-ecological considerations. Finally, interacting with Michel Saint Jalme initiated me to the complexity surrounding zoo management, and education, which was necessary to me to adequately approach the context of the project. Indeed, running such a social science project on zoos in a research lab mainly composed of conservation biologists and ecologists necessarily implied an interdisciplinary approach. I therefore gravitated between very different spheres, with social scientists, psychoacoustic researchers, conservation biologists and zoo educators and managers. The approach I developed in this social science project is thus likely to be very different from what would have done someone with only a psychology background. I however believe that nowadays, much more collaborative works need to be initiated between conservation social and biological sciences, to achieve more successfully major conservation issues.

To conclude, I would say that I feel comfortable mobilizing methods and concepts from various disciplines, which is to my opinion necessary, and that my PhD project therefore applies to the overall research field of *conservation sciences*.

General introduction

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1. The biodiversity crisis

a. Dramatic biodiversity decline

The biodiversity crisis is nowadays largely acknowledged, with dramatic increases of number of threatened species. For instance, the International Union for Conservation of Nature (IUCN) listed increasing numbers of species as Critically Endangered (e.g. 168 to 209 mammal species) or Endangered (e.g. 31 to 810 amphibian species) from 1996 to 2015 in the red list of threatened species (IUCN 2015). Indeed, the current rate of extinction of species is as significant, if not more, as the extinction rates during the previous major biodiversity crisis. This is why some argued that we are currently facing a 6th major extinction crisis (Barnosky et al. 2011). However, the biodiversity crisis is not only the extinction of species, but more generally the decreases in numbers and the reorganization of interactions between species (e.g. predation, mutualism), and with their environment (e.g. carbon flux, water supply). According to the IUCN and the World Wide Fund (WWF), the first cause of decline of species appears to be habitat loss and alteration; other causes include exploitation (e.g. hunting, fishing, trapping and poisoning) and introduction of invasive species (IUCN 2015; WWF 2016). Increasing urbanization and human activities are part of this threat (Kerr and Currie 1995). Indeed, biodiversity levels are much reduced in urban areas (McKinney 2002), where it has been estimated that 80% of the population live, in Europe (Antrop 2004). Moreover, the biodiversity crisis, thus extinction of both species and ecological processes, have deleterious effects on the functioning of ecosystems, and, in turn, on the services that the ecosystems provide to humanity (Cardinale et al. 2012). The urgent need to reduce this biodiversity decline has thus be underlined, for various reasons: although there have been a large emphasis on considering the intrinsic (protecting nature for nature's sake) and the utilitarian (protecting nature for humans' sake) values of nature, other reasons to protect nature have been proposed, e.g. ethical reasons, consideration of the relationship between people and nature or consideration of the evolutionary effects of human actions. According to May (2011), in addition to the importance of preserving individual species because many of them have not been discovered or well studied, whereas future biotechnologies may find their genes useful (i.e. narrowly utilitarian reason), and to the importance of preserving ecosystems because humans depend on ecosystem services (i.e. broadly utilitarian reason),

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humankind has a “responsibility to hand on to future generations a planet as rich in natural wonders as the one we inherited” (i.e. ethical reason) (May 2011, p.349). More recently, Chan et al. (2016) suggested that considering the protection of nature for humans’ sake (instrumental values) or for nature’s (intrinsic values) is not sufficient, and that a third class of values should be framed: relational values. They indeed proposed to integrate a value pertaining the relationship between people and nature, including relationships that are between people but involve nature.

To face the biodiversity crisis, several governments in the world agreed on a Convention for Biological Diversity, at the United Nations Conference on Environment and Development (the Rio “Earth Summit”) in 1992, a convention which received 168 signatures by 1993. In 2010, a Strategic Plan for Biodiversity 2011-2020 was defined to counteract the loss of biodiversity on the planet, and proposed five strategic goals and 20 targets called “Aichi Biodiversity Targets”, some of which including consideration of human feelings and behaviors in the conservation objectives; for instance, the first target states that “by 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably” (Convention for Biological Diversity 2010). This therefore highlights that the biodiversity crisis and the fact that humans are part of this issue are considered at a global level.

b. The emerging field of conservation psychology

In parallel to the international and political mobilization, this growing concern led to the grouping of numerous disciplines, mostly ecology, to form a single, more engaged, “crisis” discipline, *conservation biology*, aiming at providing principles and tools for preserving biodiversity (Soulé 1985). This discipline focuses on a large extent on the impact of climate change and of human activities on biodiversity and its dynamics. For instance, Olson et al. (2002) in an editorial of *Conservation Biology* journal insisted in the need for much research effort on the minimum-area requirements for species and ecological processes, on the conservation of large-scale processes and widespread species, on a better understanding of beta diversity (i.e. ratio between regional and local species diversity) and endemism, and on

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predictions of the threats to biodiversity (i.e. location and intensity). However, research focused back on the impact of biodiversity on humans, for health, individual well-being, but also for conservation issues (e.g. research devoted to environmentally-responsible behavior), is much more recent. Indeed, conservation biologists have more recently acknowledged that conservation problems cannot be solved solely with ecological knowledge (Mascia et al. 2003), and that more social sciences are also needed to achieve conservation issues (Lidicker 1998 in Saunders 2003). Very similarly as *conservation biology*, *conservation psychology* emerged from various disciplines from the social sciences (Fig.1), to “create stronger connections between the natural and social sciences, between research and practice, and between psychology and the other social sciences” (Saunders 2003, p.137). This new discipline aimed to understand reciprocal human-nature relationships, with an ultimate goal of encouraging conservation of the natural world (Saunders 2003). In this sense, conservation psychology is also an engaged discipline. This field is emerging more widely, with dedicated books and handbooks (Clayton and Myers 2009; Clayton 2012b), and dedicated workshops and training courses (e.g. Conservation Psychology Institute, June 12-15, 2016 at Antioch University, United States).

Another field study focusing on human-nature relationships already existed at the time of the creation of Conservation Psychology: Environmental Psychology. This was indeed formally recognized during the 1970s by the American Psychological Association, and is most like conservation psychology. However, there are significant ways in which those two fields differ: “Conservation Psychology emphasizes relationships with the natural world, whereas Environmental Psychology focuses on both the built and natural environments”, “Conservation Psychology is envisioned to function more like a superfield rather than a subdiscipline”, “Conservation Psychology actively recruits large numbers of other psychology specialists to apply their skills to conservation problems”, “Conservation Psychology attempts to catalyze contributions from other social sciences by orienting more strongly around a conservation mission”, and “Conservation Psychology practitioners play a strong role in helping to shape the research questions” (Saunders 2003, p139-140).

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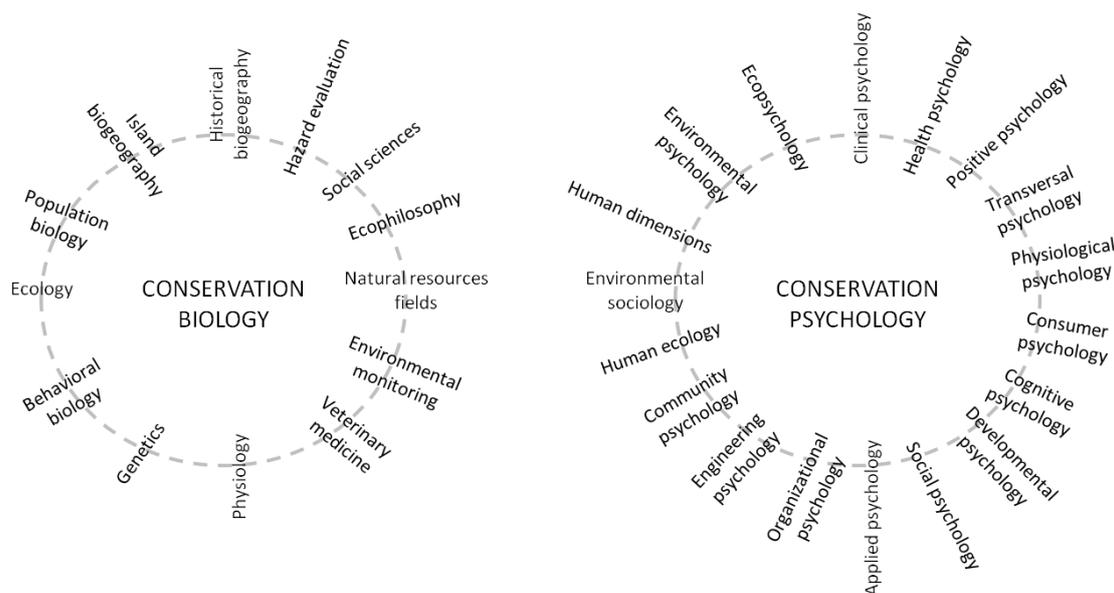


Figure 1: Conservation biology and conservation psychology both mobilize contributions from other fields and subdisciplines toward conservation-related missions (Taken from Saunders 2003).

2. Human-nature relationships

a. Various concepts to define human-nature relationships

Much research effort has focused on exploring human-nature relationships, by exploring how connected humans feel with the natural world (see Tam 2013 for a review of existing concepts). For instance, Mayer and Frantz (2004) developed the concept of *Connectedness To Nature*, measuring through a list of 17 items and a 5-point scale (Strongly disagree to Strongly agree) the extent to which people generally feel a part of the natural world, with an emphasis on the affective and emotional components of the relationship and sense of belonging to the natural world (e.g. “I think of the natural world as a community to which I belong”). W. Schultz proposed another measure of the relationship to nature: the *Inclusion of Nature in the Self* (INS) is based on the principle stating that a person who feels connected to someone else, is likely to develop a cognitive schema about this relationship by visualizing an overlap between the knowledge structure of the self and the knowledge structure about this relationship partner (Aron et al. 1991). W. Schultz adapted a single-item graphical

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measure, composed of seven pairs of overlapping circles, labeled *self* and *nature* (Schultz 2001, adapted from Aron, Aron, and Smollan 1992; Fig. 2).

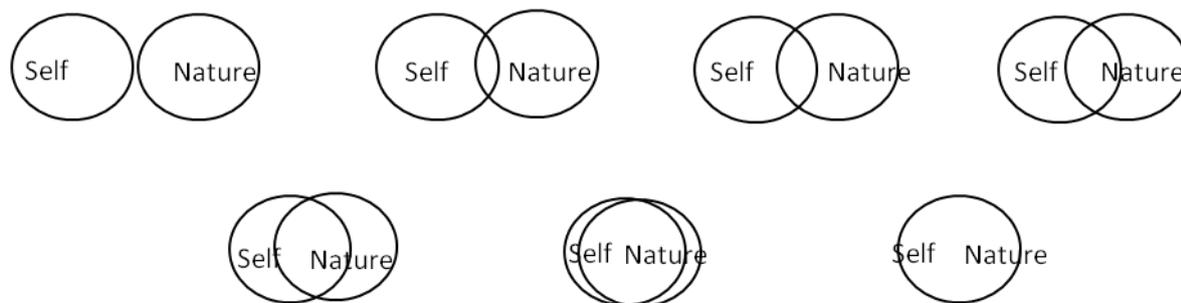


Figure 2: Inclusion of Nature in the Self scale (INS) (Schultz 2001, adapted from Aron, Aron, and Smollan 1992).

Whereas these two previous measures mostly explore sense of connection on a single dimension, and thus identify a specific aspect of it, others explicitly conceptualized connectedness with nature using various dimensions. Thus, Clayton proposed the concept of *environmental identity*, measured through a list of 12 items, which she defined as the sense of connection with the non-human environment, that affects the way people perceive and act toward the world, and the belief that the environment is important and forms a subsequent part in self (Clayton 2003). Nisbet et al. (2009) developed the Nature Relatedness scale assessing the affective, cognitive and experiential aspects of individuals' connection to nature through a list of 30 items exploring those three dimensions. Although this 30-items measure appears to be much more complex than the single item measure of Inclusion of Nature in the Self previously mentioned, a strong correlation has been found between those two measures (Zelenski and Nisbet 2012). Similarly, all the measures of connectedness to nature we mentioned above were compared with a widely used measure of proenvironmental orientation, the Dunlap and Van Liere's New Environmental Paradigm Scale (Dunlap and Liere 1978; Dunlap et al. 2000). The New Environmental Paradigm consists in a 15-item scale measuring how humans interact with nature. Connectedness To Nature, Inclusion of Nature in the Self and Nature Relatedness were found to all correlate to the New Environmental Paradigm (Mayer and Frantz 2004; Schultz 2001; Nisbet, Zelenski, and Murphy 2009), suggesting that all these measures capture common features of people's

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sense of connection to nature. Prévot et al. (2016) formalized a typology of six complementary dimensions of individual relations to urban nature, ranging from an affective to an utilitarian dimension, and showed that these dimensions are not independent, but instead they are complementary, and shared by both lay people and conservationists.

Despite their diversity, such attempts to define people sense of connection and relations to nature mostly relied on how people perceive and like the natural world, rather than how they physically experience it. This latter aspect has indeed only been considered in the Nature Relatedness scale (e.g. one of the item is “I enjoy digging in the earth and getting dirt on my hands”), along with other dimensions of human-nature relationship (Nisbet, Zelenski, and Murphy 2009). The concept of experience of nature has been previously used in the literature (e.g. Pyle 2003; Soga and Gaston 2016), but never clearly defined. Soga and Gaston (2016) indeed referred to “a wide diversity of types of human-nature interactions” for defining the “experience of nature”, and mostly referred to contacts with nature in the literature review they conducted. However, the “experience” has been defined in the Cambridge dictionary as the “process of getting knowledge or skills from doing, seeing or feeling things” or as “something that happens to you that affects how you feel” (dictionary.cambridge.org). Thus, the “experience of nature” is not limited to contacts with the natural world, but appears to be a process affecting more deeply people. In addition, there is a large diversity of experiences of nature which, similarly as for relationships with nature, vary from one individual to another. Of course, relationship with nature and experience of nature are closely related, as for instance experiences with nature during childhood have been found to strongly affect environmental identity (Chawla 1988).

b. The so-called “extinction of [nature] experience”

The on-going biodiversity decline and our growing urban lifestyles progressively decrease opportunities to experience nature mostly for people living in Western countries. Indeed, as mentioned above, in European countries 80% of the population live in urban areas (Antrop 2004; United Nations 2011), and people in western societies spend 90% of their time inside buildings (Evans and McCoy 1998). Moreover, people who live farther from natural areas

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interact less frequently with nature (Soga et al. 2015); empirical evidence also demonstrates that children today spend less time interacting with the natural world, as compared with previous generations (see Soga and Gaston 2016 for a review). All other things being equal, this loss of opportunities to experience nature inevitably led to a reduction of direct human-nature interactions. Pyle (1978; 2003) has termed this phenomenon the “extinction of experience”, and described it as the growing habituation of people to the absence of common species of plants and animals that rarefy from their everyday environs. More recently, Soga and Gaston (2016) highlighted that a loss of orientations – or willingness – toward the natural world is also an important driver of this reduction of contacts with nature. Indeed, there is evidence that the level of an individual’s emotional connectedness to nature is positively correlated with the frequency of visits to natural places (Mayer and Frantz 2004; Nisbet, Zelenski, and Murphy 2009). Besides, there is evidence that children today have a greater knowledge of synthetic (i.e. Pokemon® characters) or exotic species than real or local wildlife (American sample of children, Balmford et al. 2002; French sample of children, Ballouard, Brischoux, and Bonnet 2011). According to Soga and Gaston (2016), although the “extinction of experience” is caused by both loss of opportunity and loss of orientations, this reduction of human-nature interactions has consequences on human health and well-being, as well as on emotions and attitudes toward the natural world, which in turn affect behaviors, and these consequences can then lead to a feedback loop and accelerate further loss of interactions with nature. An intimate relationship with nature has however many benefits, on human health (Mitchell and Popham 2008), individual well-being (Howell et al. 2011), attention restoration (Kaplan and Kaplan 1989), but also for environmental issues. This is why Miller (2005) underlined the urgent need to reconnect people to nature to achieve more fully conservation goals, by increasing both opportunities and orientations in tandem (Soga and Gaston 2016a).

However, as we mentioned above, the “experience” refers to more than simply contacts with nature. Additionally, rather than just disappearing, the experience of nature appears to be gradually changing, as an effect of modernity and should be considered in its diversity and dynamical complexity, rather than striving for an idealized relationship (see manuscript 6 in Appendix for reconceptualization of the “extinction of experience”).

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“Reconnecting” people to nature here refers to the need to restore the more intimate *relationship* people had with nature in the previous decades. Indeed, we highlighted here that people have nowadays less opportunities and less willingness to be in direct contact with nature. It therefore appears necessary to reinforce the sense of connection people feel toward nature, by creating (new) opportunities for people to experience nature, and enhancing their willingness to do so. “Reconnection” of people with nature thus refers to the restoration of an intimate *relationship* between people and nature, through the promotion of *current nature experiences*, whatever different or new they are, rather than through the restoration of experiences people used to have with nature decades ago.

c. What kind of nature are we talking about?

The numerous studies that explored the benefits of nature referred to different kinds of “nature”: most of them relied on comparisons of “urban” versus “natural” environments (e.g. Bratman et al. 2015), of different landscapes (Han 2010) or different levels of greenery (e.g. Mitchell and Popham 2008). Studied natural places are thus commonly defined in a very imprecise manner, and little research effort assessed which categories of landscape people actually visit and to what extent. Moreover, although various scientific classifications of natural areas can be found in the literature, we still lack information on what people define as “natural areas”. Indeed, it is normal that the definition of nature remains so fuzzy, because there is no consensus among ecologists and conservationists: various typology have thus been proposed to classify European habitats (e.g. Corine Land Cover: IGN 2012), and for instance, the contribution of phytosociology in defining such a typology of habitat had been controversial (Hall, Krausman, and Morrison 1997; Boitani, Mace, and Rondinini 2015). However, increasing people’s opportunities and willingness to experience nature requires identifying the type of natural areas they already are willing to visit. As part of my PhD thesis, I therefore explored the habits of nature use in a large sample of French respondents (N=4 639) (see manuscript at the end of introduction for the complete study). I obtained such a large sample size by pooling data from five independent surveys that aimed all at a better understanding of human-nature relationships (e.g. virtual or particular experiences of nature). Surveyed groups were as following: (1) 1126 students from various disciplines (i.e.

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biology, ecology, mathematics and politics), (2) 1172 adult players of an online role-playing game (World of Warcraft®), (3) 446 visitors of three zoos in France¹, (4) 342 respondents to an online questionnaire sent by email using the snowball sampling technique (Biernacki and Waldorf 1981) or through online social network (Facebook®), and (5) 1553 people who participated in an “animal adoption program” at Paris’ zoo². Every person had to indicate his/her frequency of visits of natural places, and, as an open-ended question, in which natural place s/he mostly goes.

We obtained a total of 7761 quoted natural places, because respondents were allowed to give several answers. Crosschecking for identical places led to 678 different natural places. We found that 16 of these natural places were each quoted by at least 50 persons (i.e. 5912 quotes), and so represented 76.2% of the total quoted places (Fig. 3). More specifically, the five first of these places represented 54% (i.e. 4194 quotes) of the total quoted places, suggesting a common appeal for those places among all the respondents, and consistently among surveyed groups: forests, parks, countryside, mountains and gardens. The first result of this study is therefore that French adults share common appeal to quite a few numbers of places that they call “nature”. However, we found still a large variability in what the respondents mentioned as “natural places”, and some of these places are not ecologically valued as “natural” by conservationists. For instance, although golf courses have been mentioned by survey respondents as natural areas, there is a large debate around such places, because their implementation often requires modification of natural habitats, and their management involves excessive use of chemicals and water; more recently, however, there have been a growing consideration of golf courses in the support of biodiversity (Colding and Folke 2008). Because they do not home high levels of biodiversity, such places are hardly valued in conservation policies. However, they still house living plants and animals and, more importantly, they are acknowledged as being nature by non-scientist people. Such places are therefore areas where people experience nature; they should be considered more thoroughly in conservation policies and landscape management, for their high potential in reconnecting people with nature and biodiversity concern.

¹ This survey was first devoted to the study reported in the chapter 3

² This survey was first devoted to the study reported in the chapter 4

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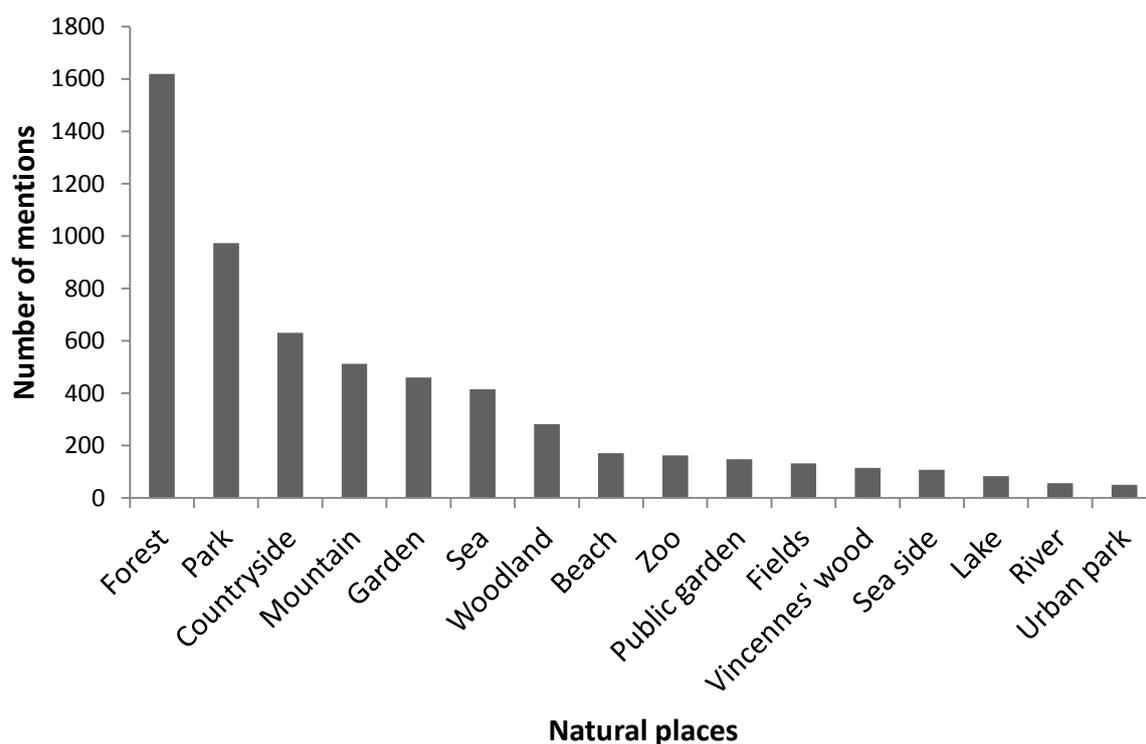


Figure 3: Number of quotes of the 16 natural places mentioned by at least 50 respondents.

The second result of this study links current habits with personal history concerning nature use. Indeed, our results (see manuscript for details) strongly suggest that nature experiences during childhood determine the type of natural places people visit at adulthood (forested or more urbanized one), as well as the way people talk about the places they visit: Individuals who have grown in more rural areas tend to go more often into forests (the opposite for people having grown in the cities); in addition, people having grown in more rural areas tend to remain general in mentioning a type of place (e.g. forests), while people having grown in more urbanized places tend to refer to more specific places (e.g. Fontainebleau's forest). These results suggest that, besides connectedness to nature (shown by Chawla 1988), childhood experiences of nature tend to impact both the experiences of nature during adulthood and their representation as place specificity in their mind.

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One important aspect of the reconnection of people to nature and conservation issues, or in other words, the restoration of a more intimate relationship between humans and nature, is thus to provide to people more opportunities for diverse nature experiences, including new ones. However, there have been growing evidence showing that vegetation is often unevenly distributed within cities, with reduced levels of vegetation for low-income, minority or other populations (e.g. Pham et al. 2012; Landry et Chakraborty 2009). Nevertheless, our investigation of the use of natural places by the public revealed that there is a large amount of places that have the potential to provide nature experiences to people, even if those same places are not valued as natural by conservationists. It therefore appears important to consider places that could potentially provide nature experiences to a large audience of people. This is the case for zoos, which are more considered as recreational places by visitors, through a desire to spend a nice moment in family for instance (Reade and Waran 1996; Moss, Jensen, and Gusset 2014). Thus, even if those who mentioned zoos were mostly from the zoo-related surveyed groups (i.e. zoo visitors and “adopters” of the zoo animals), it nevertheless means that people who visit zoos consider it natural. The zoo visit could therefore be considered as an experience of nature, either local or more exotic, regardless of the artificiality of the displayed “nature” in the zoo. This perception of the zoo as a natural place may indeed be explained by two components: the displayed animals and their natural environment that zoo designers tend to re-create.

3. Zoos as places for reconnecting people with nature?

a. Historic overview of zoos and their roles

The first zoos, in the 18th century, were not designed as immersive at all. On the opposite, animals were displayed in large numbers in very small cages or enclosures, full of concrete. The primary purpose was to exhibit exotic animals and to evoke the domination of humans over animals, and through this, the domination of humans over the natural world, an idea largely established in Western societies during this period (Baratay and Hardouin-Fugier 1998). This perception of the relationship between humans and nature changed over time, with an increasing consideration of humans as part of the natural world, rather than

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dominating it (Derex 2012). Accordingly, zoos evolved from recreational places where people could encounter a large variety of exotic animals, to effective species conservation centers in the 1990s (Rabb 2004). In parallel, a growing concern for animal well-being led zoos to improve their captivity conditions. Indeed, many visitors judge the welfare of the animal simply on what they see during their visit: enclosure style and animal behavior (Coe 1989 in Melfi, McCormick, and Gibbs 2004). Zoos have therefore invested much effort in environmental enrichment, which is defined as an improvement in the biological functioning (e.g. wild-type activity budgets, low frequencies of psychopathologies, facilitation in the expression of normal animal behavior patterns, increased reproductive and rearing success, decreased on abnormal behaviors) of captive animals through modifications to their environment (Newberry 1995). For instance, a larger amount of vegetation can be included in the enclosures to attempt “to replicate identifiable parts of the landscape of the species' habitat”, i.e. make them look more naturalistic (Fàbregas, Guillén-Salazar, and Garcés-Narro 2012). Various devices or objects can also be provided, to stimulate animal interest and thus give the animals the opportunity to express species-typical behaviors (e.g. foraging behavior). However, a right balance is necessary between the aesthetic value of the enclosure and its functional utility, since previous research noted that in the most common type of naturalistic enclosures, the occupants were denied access to the majority of the vegetation (Seidensticker and Doherty 1996 in Melfi, McCormick, and Gibbs 2004). This is why even if the enrichment devices or objects can be made of artificial materials, zoos often try to make them look as natural as possible, to display naturalistic enclosures (McPhee et al. 1998) with high functional utility in terms of animal wellbeing. The aim of this was to reproduce as much as possible the natural habitat of the displayed animal in the wild, for the animal well-being, but also for the public impression of observing wild animals in their habitat. Indeed, zoos enrich animal habitats not only to increase their wellbeing, but also because the occupants of the enriched enclosures would be more likely to display a wide range of species-typical behaviors that are attractive to the visitors (Robinson 1998). Surveys of zoo visitors indeed demonstrated that they prefer naturalistic exhibits (Reade and Waran 1996; Tofield et al. 2003), and that such naturalistic exhibits may be more effective than less naturalistic ones in increasing concern for animals (Lukas and Ross 2014).

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Zoos progressively claimed other roles than only entertainment of the public: first, they officially claim that they act for conservation, through captive breeding programs to maintain genetic diversity (WAZA 2015). Accordingly, in 1993, the EU acknowledged this conservation potential of zoos during the Convention on Biological Diversity (CBD), and obliged the zoos to manage the ex-situ and in-situ conservational role under the CBD's requirements (Rees 2005), regardless of the lack of the government's systematic financial or other support (Gippoliti 2012). However, the contribution of zoos to species conservation remains controversial among scholars, mainly because animal collections in zoos are mostly composed of large vertebrates, and at the opposite, few threatened and few endemic species (Balmford, Leader-Williams, and Green 1995; Conde et al. 2011; Fa et al. 2014; Martin et al. 2014; Frynta et al. 2013). Indeed, many zoos' financial functioning is dependent on the funds gained from visitors (Mazur and Clark 2000), which is why one of the strategy has been to display the animals people like most and expect to see at the zoo. Much research has thus shown that some species are more preferred than others, since people tend to spend more time in front of enclosures of large vertebrates, mostly mammals (Moss and Esson 2010), are more willing to spend money and efforts to see rare species (Angulo et al. 2009), and show an overall appeal for primates, because of their similarities with humans (Plous 1993). In addition, the main reason for a low number of threatened or endemic species is geographical isolation and ecological specialization of these species: species with smaller spatial ranges and those associated with high level of endemism were less likely to be held in zoos than their more cosmopolitan close relatives (Martin et al. 2014). Nevertheless, even if the contribution of zoos to ex-situ conservation (i.e. in zoos, botanical gardens) remains uncertain, zoos are one of the main financial investor of in-situ conservation programs (i.e. on the field) (Gusset and Dick 2011).

Education, and more specifically conservation education, is another important aspect of zoo culture. Indeed, conservation education, along with conservation, appeared to be a prominent theme in the zoo mission statements in 136 zoo websites across the world (Patrick et al. 2007). Zoos have thus been proposed as source of informal or *free choice learning*, i.e. self-directed, voluntary learning, that is guided by a person's needs and interests (Tofield et al. 2003). Zoos use numerous and various ways to deliver messages on

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conservation: information panels, interactive displays or activities, including encounters with zoo staffs or volunteers. Different types of signs are often displayed, some of them detailing general information on the biology of the animal or other aspects (e.g. species conservation in general, concept of environmental enrichment), whereas other signs attempts to help visitors bond with animals, by highlighting the threat of extinction for instance (Tofield et al. 2003). However, very few visitors actually read signs, and those who do only read them very briefly (Tofield et al. 2003; Clayton, Fraser, and Saunders 2009). Exhibit design is another important element contributing to *free choice learning*, as more naturalistic exhibits have been found to catch more visitors' interest than less naturalistic ones (Tofield et al. 2003). Indeed, visitors' learning comes as much from signs or dedicated educational programs at the zoo as from simply observing the animals and exhibits themselves (Tofield et al. 2003). Therefore, zoos, through a wide diversity of educational medium, seem to provide a successful source of learning, since a recent global survey proved that both adult and younger visitors generally exit the zoo with an increased knowledge on biodiversity (Jensen 2014; Moss, Jensen, and Gusset 2015).

Zoos therefore have various missions, which they can differently fulfill. For instance, some zoos more strongly highlight their conservation mission, while others put large efforts in educational strategies. However, as mentioned above, although the zoo visit is not literally claimed as for recreational purpose, when asked about their motivation to visit the zoo, many visitors mentioned the desire to spend a good time in family or with friends (Reade and Waran 1996; Tofield et al. 2003). Accordingly, although the content of 54 websites of zoos around the world rarely mentioned the words "entertainment" or "recreation", they largely highlighted the recreational aspect of the visit, through use of other words instead, such as "attractions", "encounters", "what to do", "feeding", "visit the zoo", "what's on" and "fun zoo" (Carr and Cohen 2011). For instance, Paris Zoological Park recently put advertisements on its website for nocturnal visits of the zoo, and promoted this experience through arguments like watching the animals' retreat for the night and, mostly importantly, participating in playful and interactive activities and picnic (Parc Zoologique de Paris 2016); similarly, the first words of the website section dedicated to the description of the education

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mission of the Menagerie, another zoo in Paris, is “a place for family walks” (Menagerie du Jardin des Plantes 2016).

b. The multiple components of the zoo visit

Zoos indeed attract millions of visitors worldwide every year (Gusset and Dick 2011), with large amounts of groups, either family or friends, willing to share the experience of the animal encounter. The social component of the zoo visit has largely been acknowledged, since zoo animals elicit emotional responses, either positive or negative, and the sharing of these emotions favor social interactions (Clayton, Fraser, and Saunders 2009; Fraser et al. 2009). It has even been found that visitors who felt positive emotions toward captive animals were more likely to support conservation projects (Kals, Schumacher, and Montada 1999; Allen 2002; Hayward and Rothenberg 2004; Myers, Saunders, and Birjulin 2004). However, visitors' attitudes toward animals remain very complex. Besides their exotic attractiveness, zoo animals allow people to consider their human condition (Servais 2012), and to observe the wild animal nature (Cosson 2007). More precisely, animals do not all elicit the same emotional responses: for instance, people generally express fear or aversion toward invertebrates (Kellert 1993), while primates are mostly positively perceived, mainly because of their similarities with humans (Plous 1993). A survey administered to 2134 participants of the “animal adoption” program of Paris Zoological Park³ revealed that on average, people felt higher levels of positive emotions (interest, fascination, pride, joy and pleasure; mean=3.9 on a 5-point scale from 1-a little, to 5-very much) than negative emotions (sadness, fear, shame, anger and worry; mean=1.4) toward the adopted animals. Similar results were observed among 84 visitors of the Menagerie, another zoo in Paris.

In addition to provide an emotional and social experience, zoo animals also allow people a multisensory experience: indeed, compared to mass media settings (e.g. television, internet), the zoo provides visitor a tridimensional experience of animal encounter, since people can see the animals for real, but also hear, smell and sometimes touch them (Rabb 2004). This sensory experience participates in the feeling of immersion of visitors in the zoo.

³ This survey is detailed in Chapter 4.

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For instance, Ogden et al. (1993) explored the impact of natural sounds on the feeling of immersion of the visitors, by artificially playing natural sounds at zoo exhibits. They found an increased awareness of the natural environment, and increased overall learning and learning about animal-environment interactions when the natural sounds were played, compared to when the speakers were off (Ogden, Lindburg, and Maple 1993). Indeed, zoos are increasingly designed to immerse the visitors as much as possible in the habitat of the animals, and to give them the impression of an animal encounter as similar as in the wild (i.e. concept of immersive landscape, see Coe 1985). However, even if strong efforts are sometimes invested to mask physical barriers separating animals from visitors, it remains noteworthy that the zoo could enhance the idea of separation of humans from nature, through animal captivity.

In addition to display captive species and their mimicked natural environments, zoos host a diversity of urban species, for which the zoo appears to be a suitable habitat, mostly by providing food resources. Urban biodiversity integrates all living forms that participate in the ecological functioning of the place; it includes mostly horticultural plant and domestic animal species, but is not limited to them: wild species that progressively colonize cities are also part of urban biodiversity (Clergeau and Machon 2014). Thus, all natural elements at the zoo, i.e. captive species, their mimicked natural environment and urban biodiversity that is present at the zoo, have the potential to give visitors the opportunity to experience a sense of being away from their everyday lives, a need that urban dwellers growingly express, because of higher levels of stress and mental illnesses in urban settings (Ulrich et al. 1991). However, do people necessarily need to feel far away from their every day environment, through immersion in the habitat of exotic animals displayed at the zoo, or does the overall natural environment, including urban biodiversity, that the zoo contains participate in the feeling of immersion and sense of being away?

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Summary and aims of the thesis:

Given the multiple and diverse components of the zoo visit mentioned above, and the large perception of zoos as natural places, it is worth considering zoos as places for reconnecting people with nature and conservation issues. Zoos could help increase people's knowledge about biodiversity and its conservation through conservation education. However, the multisensory, social and thus memorial aspects of the zoo visit could also impact people's relationship to nature from a more affective perspective: indeed, the positive emotional and social experiences provided by the zoo visit could enhance people's likeability toward the natural world, and willingness to further experience nature and preserve it. This project thus aimed to explore the potential of zoos in reconnecting people with nature and conservation issues. To do so, we broadly explored the zoo visit experience as a preliminary study, and then worked more precisely on three research questions that we explored within three zoos that differ in size, location and animal exhibit design:

(1) What is the zoo visit experience?

Chapter 1 is dedicated to the investigation of the zoo visit experience, as a preliminary, but necessary, survey to explore visitors' motivations to visit zoos, their personal history with the zoo, their perception of animal captivity and conservation, their overall relationship with nature and the extent to which the zoo visit could constitute an experience of nature. Thirty eight groups of visitors were therefore interviewed within the three zoos.

(2) What experience of nature does the zoo provide? How do people perceive nature at the zoo?

Given that some people consider the zoo as a natural place, we further investigated visitors' perception of nature in the zoo in chapter 2, through photographs taken by visitors, who were asked to take pictures of "nature" in the zoo. We thus analyzed the content of the pictures.

Additionally, we explored visitors' perception of nature in the zoo, using an anthropological approach of the perception of the soundscape in zoos. We explored the perception of human and natural sounds, and their contribution in the feeling of immersion in the zoo.

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(3) Does a zoo visit help reconnecting people to nature?

We investigated in chapter 3 whether visitors exiting the zoo felt more connected to nature and more concerned for biodiversity than those who were entering the zoo. We also explored whether connectedness to nature and concern for biodiversity are similarly influenced for both zoo visitors and non-zoo visitors. We explored this aspect from a psychological perspective, through a questionnaire survey targeting zoo visitors and urban park users.

(4) Does the zoo help reconnecting people with conservation issues?

We explored in this part human preferences for species conservation, through their monetary donations to a species conservation program. Paris' zoo indeed created an "animal adoption program" that aimed to raise money to support conservation, and which consisted in proposing visitors the symbolic adoption of an animal of the zoo, in exchange of a monetary donation. We therefore investigated participants' real behaviors toward conservation, and thus the efficiency of the program in raising conservation awareness.

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What kind of landscape management can counteract the extinction of experience?

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Abstract

Much research has explored the effects of being in natural areas on human health, well-being and environmental concern. However, the combined effects of urbanization, biodiversity loss and the Western way of life reduce the opportunities to experience nature. Landscape management could play a prominent role in providing opportunities and motivation for people to be in nature. It is important, therefore, to understand which kinds of nature people mostly prefer and use. Based on complementary questionnaire surveys obtained from 4639 French adults, we studied the habits of nature uses, in relation to personal previous experiences and nature connectedness. We explored the type and frequency of natural areas people visit most often, the place where they grew up, and the extent to which they feel interdependent with the natural environment. In an innovative process, we assessed the place specificity of each cited natural place, by measuring the extent to which respondents mentioned a specific place (e.g. a particular forest) or remained general (e.g. forests). Among a wide range of cited natural areas, five were predominant, consistently for all samples surveyed. Interestingly, connectedness with nature was negatively related to mentions of place specificity, but positively related to frequency of visits of natural areas. These results clarify the relationship between past and present experiences of nature and sense of connectedness to nature. They can also guide future landscape management processes, in order to better coordinate the provision and the desirability of natural spaces and promote both sustainable landscapes and reconnection of people to nature.

Keywords: natural place, experience of nature, place attachment, connectedness to nature, forest, urban park

Research Highlights

- A large diversity of natural places was visited, but five types predominated.
- Places that are not valued by ecologists are considered as natural by people.
- Connectedness to nature was negatively linked to specification of environments.
- Results suggest important directions for increasing opportunity and orientation.

Introduction

One aspect of the biodiversity crisis is the “extinction of [nature] experience” (Pyle 1978; J. R. Miller 2005). In a recent review, Soga and Gaston (Soga and Gaston 2016b) proposed that urbanization and a western way of life induce both a loss of opportunities and a loss of orientation to go to natural places and experience nature; the disconnection from nature induces in turn health and well-being changes, as well as emotional, attitudinal and behavioral changes, which then affect the importance assigned to nature. Based on this feedback loop, Western modern societies face a vicious cycle regarding nature conservation.

Stopping this deleterious phenomenon requires increasing the opportunities to be in contact with nature, together with the orientation and motivation to visit natural places. First, as reviewed by Soga and Gaston (Soga and Gaston 2016b), people who live farther from natural areas interact less frequently with nature (Soga et al. 2015). Providing green infrastructures close to where people live or work could allow people to develop emotional attachment to the outdoors, and motivate them to further experience nature (Bixler, Floyd, and Hammitt 2002). However, in many cases, simply increasing opportunities to be in contact with nature is not sufficient to encourage people to seek out contact with nature. For instance, in a survey comparing park users with non-users, Lin et al. (Lin et al. 2014) found that non-park users comprised almost 40% of the surveyed population, and that this significant group of people might not use local green areas even if those areas are available close to their homes. They also found that the willingness to visit parks and experience nature was driven more by nature orientation than by opportunity. Enhancing willingness and orientations to use natural places should therefore be achieved in tandem with increasing opportunities (Soga and Gaston 2016b).

Increasing opportunities to visit natural places can be achieved through landscape planning, in which natural and green spaces are implemented in such conditions that they can be visited and used (J. R. Miller and Hobbs 2002; Soga et al. 2015). This planning should be based on accurate scientific studies, for instance related to the benefits of such places for visitors. And indeed, numerous studies have been already published about benefits of natural environments for people (Bratman, Hamilton, and Daily 2012; Sandifer, Sutton-Grier,

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and Ward 2015). However, in most of them, the studied natural places are pre-defined by the researchers: many authors focus on cities and consider urban greenspaces as the natural areas compared to urban settings (Bratman et al. 2015; Soga et al. 2015). Mitchell and Popham (Mitchell and Popham 2008) extended their definition of green spaces to parks, open spaces and agricultural areas and excluded private gardens; Han (Han 2007) presented slides of different ecological biomes to the respondents. Yet, an accurate landscape planning would benefit from assessing which categories of landscapes people actually define as “natural spaces”, as well as which ones they visit and to what extent. This knowledge could help design and plan natural landscapes that would increase real opportunities for people to go to nature.

Beyond providing opportunities to visit natural areas, landscape planning could also help increase individuals' inclination to visit natural places, by taking into account the different motivations to visit these places. According to Kaplan and Kaplan (Kaplan and Kaplan 1989), the psychological, social and physiological benefits natural settings can provide could be the drivers of humans' preference for natural environments. Many studies have explored these human-nature relationships, and explored the respective roles of individual knowledge, attitude, or representation of nature (Nisbet, Zelenski, and Murphy 2009; Clayton, Fraser, and Saunders 2009; Schultz 2000; Buijs et al. 2012). They showed in particular the importance of experiencing nature during childhood. Indeed, limited contacts with nature during childhood are suspected to decrease the prominence of environmental concern in adults (Wells and Lekies 2006; Hinds and Sparks 2008). And children nowadays visit nature less often than do adults (Soga and Gaston 2016), resulting in lower curiosity and knowledge about the natural world (Lindemann-Matthies 2006). Research suggests that an environmental identity, or stable sense of oneself as interdependent with the natural world, develops primarily during childhood (Chawla 1988). Thus, when children do not have the opportunity to spend time in nature, the result may be a weaker environmental identity when becoming adults. Environmental identity is reflected in a sense of connection to nature, which promotes attention to and concern about the natural environment (Schultz 2001; Clayton 2012a). Experiencing nature through visits to natural places during adulthood allows people to continue building their relationship with nature through memories of

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childhood events in natural environments, and thus reinforce their relationship with nature. As such, we could imagine that a prior strong affective relationship with nature may lead people to visit natural places more often during adulthood.

For a given individual, the willingness to visit natural places could be a general tendency, not tied to specific areas. However, it could also lead people to visit some specific natural places, in association with the development of an attachment to these particular places. The drivers and components of place attachment have largely been explored in social psychology (Gosling and Williams 2010; Anton and Lawrence 2014), but little research effort has focused on the role of attachment to particular natural places in an individual's relationship with nature more generally.

Despite the large amount of research on relationships to nature, little research effort seems to have focused on real behaviors, to ask which kind of natural places people do visit and in what frequency together with their previous experiences of nature and nature connectedness. Our study aimed therefore at characterizing the experience of nature of more than 4000 French adult people. To do so, as Soga and Gaston (Soga and Gaston 2016b) did, we first explored the frequency of visit to natural areas. However, we explored also two new specific assessments: first, we asked people to identify the "natural places" they visit; then, from their answers, we built an indicator of "place specificity", which approaches how a given individual appears to be attached to specific places. We studied how these three proxies of experience of nature are related to the level of nature people have been in contact with during childhood, as well as to their connectedness with nature.

Methods

Survey instrument

For the aim of this study, we pooled data from five different questionnaire surveys (respectively named "student", "wow", "zoo", "web" and "adopter"), so we had 4639 questionnaires in total. The number of questionnaires, targeted audience, aims of the original surveys, administration method and period of data collection of each questionnaire survey are detailed in Table 1. The targeted audience was French-speaking adult

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communities. The five questionnaire surveys were part of different research projects, all of which aimed at a better understanding of human-nature relationships (e.g. virtual or particular experiences of nature). The data were pooled to obtain a larger sample size, and explore whether there was an overall pattern in the results or if it differed depending on the context.

In all the surveys, we explored people's connectedness with nature, frequency of visits to natural places, natural places they primarily visit, age, gender, and rural setting during childhood; all these questions were written with the exact same wording in the five surveys.

Questions and associated computed variables

Connectedness with nature

We used an adapted version of the Inclusion of Other in the Self (IOS) scale (Aron, Aron, and Smollan 1992) to measure individuals' beliefs of how interconnected people feel with the natural world, via a series of overlapping circles labeled nature and self (Schultz 2001).

Frequency of visits of natural places

We used a 5-point scale to measure the frequency of visits to natural places, ranging from 0- "never", 1 - "few times a year", 2- "once a month", 3- "once a week", up to 4- "everyday".

Name and "place specificity" of the natural places they visit mostly

The respondents then answered the following open-ended question: "To which natural place do you mostly go?" Respondents were free to give several natural places.

Based on respondents' free answers, we computed a synthetic index of so-called "place specificity", in 3 levels: 0 for general, unspecified places (e.g. "forest", "countryside", "parks"), 1 for named or specific places (e.g. "Paris Zoo", "Vincennes park", "Britany"), 2 for owned places ("my garden", "my place", "my parents' garden"). We assigned one value (from 0 to 2) to each cited place. Several values of this index could be present for a single respondent, depending on the number of cited natural places.

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Table 1: Description of the survey instrument, with number of questionnaires, targeted audience, aim of the survey, administration method and period of data collection for each of the five pooled surveys.

Group	Number of questionnaires	Targeted audience	Aim of the survey	Administration method	Period of data collection
(1) student	1126	French university students (biology, ecology, mathematics and politics) – mostly 18-25 years old (86%) and women (47%)	Explore student's environmental identity	Printed materials - in classes	September 2013 – March 2014
(2) wow	1172	French adults players of an online role-playing game (World of Warcraft) – mostly 18-25 years old (61%) and men (84%)	Explore gamer's virtual relationship with nature	Internet-based survey	June – August 2014
(3) zoo	446	French speaking visitors of three zoos in France (two urban in Paris, one rural in the center of France) – mostly 36-40 years old (34%) and women (54%)	Explore the visitors' perception of the zoo and biodiversity conservation, and visitors' relationship with nature	Printed materials – in the zoos	July – August 2014
(4) web	342	French speaking people receiving a link by email to complete this survey or following the link posted on the Facebook page of a zoo – mostly 26-40 years old (49%) and women (65%)	Explore people's perception of the zoo, biodiversity conservation, and their relationship with nature; Compare with zoo visitors	Internet-based survey	End of April 2015
(5) adopter	1553	French speaking people who participated in the "animal adoption program" of Paris' zoo – mostly 41-60 years old (38%) and women (71%)	Explore people's motivations to adopt an animal through the zoo and their relationship with nature	Internet-based survey	April – May 2015

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Rural setting during childhood

We recorded whether participants spent their childhood in a rural or more urban setting using a 5-point scale, ranging from 1-“large city”, 2-“medium city”, 3-“small city”, 4-“village” to 5-“hamlet”.

Age

Depending on the surveys, age was assessed either through the year of birth or by category. For homogenization, we summarized all these data in five categories: 1 for people under 18, 2 for 18 to 25, 3 for 26-40, 4 for 41-60 and 5 for people above 61 years old.

Data analyses

All the analyses were performed using R 3.0.2 (R Core Team 2013).

We first examined the raw data of the three proxies of the experiences of nature (i.e. frequency of visit of natural places, names of the most visited places and index of place specificity), and we tested whether the results were consistent between the different surveyed groups using chi-squared tests.

Then, we explored the relations between current experiences of nature and individual characteristics, in the following ways:

Determinants of the frequency of visit to natural places

We used a linear regression to explore determinants of the frequency of visit of natural places, with the frequency of visit of natural places (VIS) as the response variable, and rural setting during childhood (RUR), connectedness with nature (INS), age (AGE), gender (SEX) and group (GPE) as the independent variables. The group variable was only included in the model to take into account differences between groups (see results). We also considered interactions between RUR, INS, AGE and SEX. We then applied a stepwise model selection

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based on Akaike information criterion (AIC) scores to select the best model. Finally, we conducted a type III-anova on the best model we selected (Fox and Weisberg 2016).

Determinants of visits of the most cited natural places

We used logistic regressions to explore whether visiting the most cited natural places could be predicted by connectedness with nature (INS), rural setting during childhood (RUR), age (AGE), gender of respondents (SEX) and surveyed group (GPE). We also added the frequency of visits to natural places during adulthood (VIS) among explanatory variables, because we could not exclude the possibility that the identity of the most visited places depend on the frequency individuals with which generally visit natural areas. Interactions between INS, RUR, AGE and SEX were also considered.

We entered the cited natural place (binary data set, showing whether each respondent named this specific place or not) as the response variable, and INS, RUR, VIS, SEX, AGE and GPE as independent variables. We applied this procedure for the two most quoted natural places in the whole data set, i.e. forest and park (see results). We then applied a stepwise model selection based on Akaike information criterion (AIC) scores to select the best model for each natural place (i.e. forest and park). Finally, we conducted a type III anova on the best model we selected (Fox and Weisberg 2016).

Determinants of place specificity

We modeled determinants of place specificity using ordinal regression model (Haubo 2015) with place specificity (PSP) as the response variable and rural setting during childhood (RUR), age (AGE), gender (SEX), connectedness with nature (INS), frequency of visits of natural places during adulthood (VIS) and surveyed group (GPE) as independent variables. We also considered interactions between RUR, AGE, SEX, INS and VIS. Because participants were allowed to give several responses, we built for this analysis a separate dataset containing as much replications of each individual's information as the number of natural places he/she mentioned. In other words, if an individual mentioned two natural places, this individual

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appeared twice in the data set. We thus applied a random effect to the participant variable, to control for multiple responses of natural places per person.

We then conducted a stepwise model selection based on Akaike information criterion (AIC) scores to select the best model.

Results

Description of the sample set

For all surveyed groups, age was negatively related to rural setting during childhood (the relationship was similar but not significant for two of the samples, web and zoo – groups with low amounts of data), suggesting that older persons were more likely to have grown up in urban places.

Similarly, for all groups, age was positively related to INS, suggesting that older persons were more likely to feel more connected to nature (the relationship was not significant among three of the samples, adopters, wow and zoo), and INS was positively related to rural setting during childhood, suggesting that those who grew up in a more rural place were more likely to feel more connected to nature.

Distribution of the three proxies of experience of nature among 4639 French adults

Frequency of visit to natural places:

Frequency of visit to natural places significantly differed between the surveyed groups ($\chi=755.41$, $df=16$, $p < 2.2e-16$). All surveyed groups were consistent in the score 0 (“never”, 0 to 4% of respondents in each survey), as well as in the score 3 (“once a week”, 32 to 44% of respondents). However, there was a large variation between surveyed groups for other frequencies (i.e. 1 – “once a year”, 2 – “once a month”, and 4 – “every day”; proportion of respondents varied from 11 to 34%).

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Quoted natural places

We analyzed data from 4639 questionnaires, leading to a total of 7761 cited natural places in total, due to multiple answers (up to 8). Crosschecking for identical places led to 678 different natural places. We found that 16 of these natural places were each named by at least 50 persons (i.e. 5912 mentions), and so represented 76.2% of the total named places (Table 2). More specifically, 54% of the total mentions (i.e. 4194 mentions) were represented by only five different places: forest, park, countryside, mountain and garden (Table 2). “Woodland” and “forest”, as well as “parks” and “urban parks”, were not aggregated on purpose, to take into account respondent’s specific responses, but these places are very similar and might have been aggregated. Combining these two first categories could lead the “forest” type response increasing up to 40% mentions. Other places cited by at least 50 persons included sea, woodland, beach, zoo, public garden, fields, Vincennes’ wood (i.e. a public natural area located in Paris), sea side, lake, river and urban park (Table 2).

To test whether the results were consistent across the five survey groups, we ranked the most named natural places for each group (see Supporting Information). Forested areas were the most cited areas in each of the five groups. Parks and countryside also ranked within the five first places, while mountains and gardens ranked from the 2nd place (garden, for the “web” group) to the 8th (mountain, for the “web” group). Ranks for the five most cited places did not significantly differ from one group to another ($\chi = 8.32$, $df=16$, $p=0.94$). This suggests high consistency in the answers of the five groups of respondents, although they are composed of very different people.

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Table 2: List of the most quoted natural places, with respective number of quotes, cumulative numbers of quotes and cumulative percentage of quotes. Natural places are translated from the French quoted places (in italics). « Park » stands for people who quoted “park” without specifying which type of park (other places include “national park” for instance). “Others” stands for all other responses quoted by less than 50 participants.

Natural place	# quotes	# cumulative quotes	% cumulative quotes
Forest (<i>forêt</i>)	1619	1619	20.9
Park (<i>parc</i>)	973	2592	33.4
Countryside (<i>campagne</i>)	630	3222	41.5
Mountain (<i>montagne</i>)	512	3734	48.1
Garden (<i>jardin</i>)	460	4194	54
Sea (<i>mer</i>)	415	4609	59.4
Woodland (<i>bois</i>)	281	4890	63
Beach (<i>plage</i>)	171	5061	65.2
Zoo (<i>zoo</i>)	162	5223	67.3
Public garden (<i>jardin public</i>)	147	5370	69.2
Fields (<i>champs</i>)	132	5502	70.9
Vincennes' wood (<i>bois de Vincennes</i>)	114	5616	72.3
Sea side (<i>bord de mer</i>)	107	5723	73.7
Lake (<i>lac</i>)	83	5806	74.8
River (<i>rivière</i>)	56	5862	75.5
Urban park (<i>parc urbain</i>)	50	5912	76.2
Others	1849	7761	100

Place specificity

Most natural places mentioned (67 to 90%) in all surveyed groups were general, unspecified places (scored as 0), while the least frequently mentioned (3 to 11%) were owned places (scored as 2). However, proportions of each level of place specificity significantly differed between the surveyed groups ($\chi^2=271.00$, $df=8$, $p < 2.2e-16$): e.g. the “wow” and “student” groups largely differ, with less scores of 0, but more scores of 1 and 2 for the “wow” group, and more places scored as 0, and less places scored as 1 and 2 for the “student” group. Other group scores vary between the values of those two groups.

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In the following analyses, we considered the overall data set for determinants of adult experiences of nature. However, because we found differences between the five groups of respondents for two of the three proxies of experiences of nature, we included the surveyed group as an independent variable, to take such differences into account in the models.

Determinants of adult experiences of nature

Determinant of the frequency of visit to natural places

According to the best model from the stepwise model selection (Table 3), rural setting during childhood and connectedness with nature were both strongly and positively associated with frequency of visit of natural places during adulthood (RUR: $F=85.546$, $df=1$, $p<0.001$; INS: $F=261.013$, $df=1$, $p<0.001$), suggesting that respondents who spent their childhood in a rural place and those who feel more connected to nature are more likely to visit more often natural places than other respondents. As previously found in the descriptive analysis, we found a significant effect of the group variable ($F=36.325$, $df=4$, $p<0.001$). Some interactions were also significant (Table 3), suggesting that the frequency of visits to natural places was relatively lower for older respondents who spent their childhood in a rural setting (negative effect of RUR:AGE; $F=14.085$, $df=1$, $p<0.001$), for older respondents who felt more connected to nature (negative effect of INS:AGE; $F=9.538$, $df=1$, $p=0.002$), and for men who felt more connected to nature (negative effect of INS:SEXm; $F=6.568$, $df=1$, $p=0.010$), but that this frequency of visits to natural places was higher for men who spent their childhood in a rural setting (positive effect of RUR:SEXm; $F=5.040$, $df=1$, $p=0.025$).

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Determinants of the two most quoted natural places: forests and parks

Based on the best model in the logistic regression (see Table 3), forests were more often mentioned by people having spent their childhood in more rural places (positive effect of RUR; $F=25.808$, $df=1$, $p < 0.001$), being more connected to nature (positive effect of INS; $F=16.133$, $df=1$, $p < 0.001$) and visiting more often natural spaces (positive effect of VIS; $F=13.821$, $df=1$, $p < 0.001$); at the opposite, the older the respondents were, the less they mentioned “forest” (negative effect of AGE; $F=5.956$, $df=1$, $p < 0.05$). We also found significant differences between groups ($F=116.048$, $df=4$, $p < 0.001$) and between men and women ($F=9.762$, $df=1$, $p=0.002$), with a larger number of “forest” responses for men. We found some significant interactions, suggesting that the propensity of “forest” responses was lower for older respondents who felt more connected to nature (negative effect of INS:AGE; $F=4.175$, $df=1$, $p = 0.041$), and for older respondents who spent their childhood in a rural setting (negative effect of RUR:AGE; $F=5.075$, $df=1$, $p = 0.024$), but that the propensity of “forest” responses was higher for men who spent their childhood in a rural setting (positive effect of RUR:SEXm; $F=8.088$, $df=1$, $p = 0.004$).

Similarly to “forest”, the term “park” was significantly less often mentioned by older people (negative effect of AGE; 46.482 , $df=1$, $p < 0.001$). However, based on the best model in the logistic regression (see Table 3), the mention of “park” significantly decreased with rural setting during childhood (negative effect of RUR; $F=41.218$, $df=1$, $p < 0.001$), as well as with the connection to nature (negative effect of INS; $F=6.086$, $df=1$, $p = 0.014$). We found significant differences between groups ($F=152.137$, $df=4$, $p < 0.001$) and between men and women ($F=14.293$, $df=1$, $p < 0.001$), with a lower number of “park” responses for men. The frequency of visit to natural places did not have any significant effect. Finally, we found some significant interactions, suggesting that the propensity of “park” responses was lower for respondents who visit natural places more often and who spent their childhood in a rural setting (negative effect of RUR:VIS; $F=21.485$, $df=1$, $p<0.001$) and for men who visit natural places more often (negative effect of VIS:SEXm; $F=4.553$, $df=1$, $p=0.033$), but this propensity of “park” responses was higher for older respondents who spent their childhood in a rural setting (positive effect of RUR:AGE; $F=24.932$, $df=1$, $p<0.001$).

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Determinant of place specificity

Based on the best model in the ordinal regression (see Table 3), respondents who spent their childhood in a rural place and those who feel more connected to nature were more likely to mention a low level of place specificity, or in other words, very general, unspecified natural places (i.e. level 0 of place specificity; negative effects of RUR: $\beta=-0.121$, $SE=0.032$, $p < 0.001$; negative effect of INS: $\beta=-0.088$, $SE=0.031$, $p = 0.005$). At the opposite, the frequency of visit to natural places was positively associated with scores of place specificity (positive effect of VIS: $\beta=0.320$, $SE=0.033$, $p < 0.001$), suggesting that those who mention very frequent visits to natural places were more likely to mention specific (level 1 of PSP) or owned natural places (level 2 of PSP). As we found in the descriptive analysis, place specificity significantly differed between surveyed groups. Place specificity did not differ between men and women (SEX: $\beta=0.071$, $SE=0.069$, $p = 0.304$).

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Table 3: Stepwise model selections based on Akaike Information Criterion (AIC), for determinants of frequency of visits to natural places, determinants of the two most cited natural places, and determinants of place specificity (VIS: Frequency of visit to natural places; GPE: surveyed group; AGE: age; SEX: gender; RUR: rurality level of place of childhood; INS: connectedness with nature; PSP: place specificity). The selected final models are in bold characters.

Models	AIC
<i>Determinants of frequency of visit to natural places</i>	
VIS ~ GPE + AGE + SEX + RUR + INS	10988.73
VIS ~ GPE + AGE + SEX + RUR + INS + AGE:SEX + AGE:RUR + AGE:INS + SEX:RUR + SEX:INS + RUR:INS	10953.39
VIS ~ GPE + AGE + RUR + INS + AGE:SEX + AGE:RUR + AGE:INS + SEX:RUR + SEX:INS + RUR:INS	10951.42
VIS ~ GPE + RUR + INS + AGE:SEX + AGE:RUR + AGE:INS + SEX:RUR + SEX:INS + RUR:INS	10951.42
VIS ~ GPE + RUR + INS + AGE:SEX + AGE:RUR + AGE:INS + SEX:RUR + SEX:INS	10949.53
<i>Determinants of the two most quoted natural places</i>	
'Forest' ~ GPE + RUR + INS + VIS + AGE + SEX + RUR:INS + RUR:VIS + RUR:AGE + RUR:SEX + INS:VIS + INS:AGE + INS:SEX + VIS:AGE + VIS:SEX + AGE:SEX	5411.7
'Forest' ~ GPE + RUR + INS + VIS + AGE + SEX	5415.3
'Forest' ~ GPE + RUR + INS + VIS + AGE + SEX + RUR:SEX + INS:VIS + INS:AGE + INS:SEX + VIS:AGE + VIS:SEX + AGE:SEX	5407.2
'Forest' ~ GPE + RUR + INS + VIS + AGE + SEX + RUR:SEX + INS:AGE + INS:SEX + VIS:AGE + VIS:SEX + AGE:SEX	5405.8
'Forest' ~ GPE + RUR + INS + VIS + AGE + SEX + RUR:SEX + INS:AGE + VIS:AGE	5400.9
<i>Determinants of place specificity</i>	
PSP ~ GPE + INS + RUR + VIS + AGE + SEX	8902.61
PSP ~ GPE + INS + RUR + VIS + AGE + SEX + INS:RUR + INS:VIS + INS:AGE + INS:SEX + RUR:VIS + RUR:AGE + RUR:SEX + VIS:AGE + VIS:SEX + AGE:SEX	8902.86
PSP ~ GPE + INS + RUR + VIS + AGE	8901.67

Discussion

Our results add some key features to understand what landscapes are considered as natural places and are visited most often, as well as to propose some indications to help increase opportunities and orientations to go to nature and decrease the extinction of experience (Soga and Gaston 2016b).

Perception and determinants of natural areas

Our results revealed a high diversity of places cited as “natural” by a large sampling of French adult population: more than 600 different places were cited, including forested, agricultural, urban or coastal areas, but also more recreational areas such as zoos or golf courses. Would this diversity correspond to so-called “natural places” according to ecology? Among the recent ecological classifications of land occupancy (including both natural and non natural areas), the European Corine Land Cover (CLC) (IGN 2012a) has been extensively used by ecologists. The five main levels of the CLC classification are (1) artificial surfaces, (2) agricultural areas, (3) forest and semi natural areas, (4) wetlands and (5) water bodies. Indeed, many quoted places from our survey could be classified into one out of the five categories of the CLC; however, numerous other quotations of so-called natural places did not correspond to this typology. For instance, the quoted “Vincennes’ Wood”, a public park located in Paris, France, is roughly composed of a strongly managed open field with a lake, and a less managed forest. When a respondent indicated “Vincennes’ wood”, he did not specify whether he meant the more artificial part of the place, or the forested one. Similarly, many people mentioned visiting the “countryside”, a place which could hardly be classified with the CLC; although some people may refer to the agricultural lands, other could refer to forested and semi natural areas.

Our results can be discussed together with a recent survey in Austria (Voigt and Wurster 2014): when visitors to a specific natural place were asked to cite the landscape structures that attracted their attention (open question) they mentioned almost all the categories of biotope that correspond to scientific ecological definition, even if their answers mostly did not fit exactly into the biotope classification. Consistently, when asking globally which natural areas people mostly visit (i.e. our study), a wide range of responses did not fit with

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ecological classification of natural areas. On the contrary, people can consider as “natural” some places that are not ecologically valued as natural by conservationists. This suggests that, in addition to their ecological value (for instance in terms of biodiversity), some places should be valued in terms of nature experiences and reconnection potential of individuals with nature, thereby having an indirect effect on conservation. Such varying points of views have also been observed between different stakeholders, for instance between farming and non-farming landowners in modeling scenarios for implementing sustainable landscapes (Southern et al. 2011). This thus highlights the importance of considering perceptions of various stakeholders, and in our case, the lay public’s perception of natural areas, for landscape management strategies focused on providing green spaces where people live and work.

Besides the large variety of natural places listed, our second result is the high congruency of most of the respondents regarding few of those places, regardless of the surveyed groups: over the 600 different places cited, the five mentioned most often quoted represented 54% of the total. The most often quoted place was forest. This result is not surprising since one-third of French territory (16.3 million ha) is covered by forests (IGN 2012b), a higher proportion than any other landscape use except agriculture. The fact that forests have been cited more often than countryside could be explained by limited public accessibility to agricultural fields in France, compared to forests, which are mostly owned by the State and opened to the public. However, the predominance of forests also suggests a very large appeal for forests, consistent with a large survey conducted almost 20 years ago on French respondents, which indicated that French forests are visited each year by the majority of the population (Dufour and Loisel 1996). This appeal may be explained by psychological reasons. Indeed, various studies revealed the high psychological restorative power of forest areas compared to urban ones (J. Roe, Aspinall, and Thompson 2009; Park et al. 2010). A recent study focusing on urban environments confirmed the recovery power of trees: it showed that a greater tree coverage in urban streets improved the recovery from a stressful experience (Jiang et al. 2014). Complementarily, forests, even highly managed by humans, still represent “nature, which is supposed to be largely free from human activities or left in

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its original state (...) and a region of wilderness which seems to be different from the intensively used urban area" (Schmithüsen and Wild-Eck 2000). Indeed, 70% of the French population believed more than twenty years ago that forests have to be protected in order to maintain the natural ecosystems (Dufour and Loisel 1996).

The second mostly frequently listed "natural place" was "parks". In France, "park" usually refers to urban parks in people's mind. Most cities worldwide display urban parks of various sizes, compositions and management practices. Although urbanization negatively affects biodiversity (McKinney 2002), a recent study showed that even small urban greenspaces can harbor great levels of biodiversity, and that management practices could play an important role in enhancing plant and animal diversities (Shwartz et al. 2013). Moreover, in addition to the direct benefits they provide to people, such as recreation, well-being or restoration (Chiesura 2004), urban parks can help mitigate the effects of climate change (Pickett et al. 2011), provide wildlife habitat and preserve biodiversity (Kowarik 2011). Here, we showed that these parks are indeed considered as natural by people. They could therefore help reconnecting people to nature, as proposed by Miller and Hobbs (J. R. Miller and Hobbs 2002).

Respondents who spent their childhood in a rural environment and those who feel more connected with nature were more likely to mention forests. At the opposite, respondents who spent their childhood in more urbanized areas and those with a lower connectedness with nature were more likely to mention the "park" response. These opposite effects of rurality of place of childhood and connectedness with nature on the propensity of "forest" and "park" responses are striking. Because in France "park" usually refers to urban parks in people's mind, these results strongly suggest that the rurality level of place of childhood and connectedness with nature have determinants effects on the propensity of visits to either a forested or a more urbanized area. Although it remains unsure whether accessibility could prevent urban dwellers from visiting a forest for instance, recent research has shown that many people do not use green spaces they have access to, and authors suggested that orientations were stronger determinants of people's motivations to visit a park, compared to

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opportunities (Lin et al. 2014). Our results suggest that childhood experiences could partly determine the propensity to consider as natural and visit some specific places.

Strong effect of childhood experiences of nature

Our results also revealed that the frequency of visit to natural places at adulthood was strongly related to connectedness with nature and childhood experiences of nature. They are consistent with different recent results on the relations between childhood and adult behaviors: Gifford and Nilsson (Gifford and Nilsson 2014) suggested that people in rural areas tend to have more contact with nature than those in urban ones; Thompson et al. (Thompson, Aspinall, and Montarzino 2008) found that people who had frequent visits of natural place during childhood were more prepared to visit woodlands or green spaces alone as an adult. More generally, a growing consensus says that individual environmental identity is built during childhood (Chawla 1988), and that nature experiences during childhood affects adult's pro-environmental behaviors (Wells and Lekies 2006; Hinds and Sparks 2008).

More innovatively, we found that the connectedness with nature and childhood experiences of nature also influenced the score of place specificity, which we believe is a derived measure of the degree to which a person is tied to the place he/she visits. In the literature, place attachment and connectedness with nature have been mostly explored separately, assuming that connectedness with nature is a measure of the attachment to natural places (Gosling and Williams 2010). In our study, the score of place specificity was negatively correlated with connectedness with nature, stating that people who feel more connected to nature are less likely to specify particular places. We therefore suggest that a high sense of connection to nature could be detached from any specific place, with people appreciating and being comfortable in any kind of natural place. Finally, we suggest that the positive link we found between age and score of place specificity might be due to a greater access to a personal garden and stronger habits when becoming older. Indeed, settling in a place and residing there for many years could provide this place meanings associated with several life stages, such as marrying, having children and getting old: this results in "a rich network of

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place-related meanings, and offers a deep sense of self-continuity, something that more mobile people do not experience” (Lewicka 2011).

Management implications

There is a growing consensus that we need to provide green spaces near to where people live and work, especially because exposure to nature tends to be positively related to the amount of neighborhood available urban green (Soga et al. 2015). Our results on the strong effect of childhood experiences of nature on frequency of visit, type of and place specificity of natural places underline the importance of also providing green spaces where young people live, as well as motivating parents to bring their children to these places, and/or implementing nature-based educational programs at school (Lindemann-Matthies 2006). Providing children more opportunities to experience nature will also provide them opportunities to reinforce their emotional ties with nature, and thus increase their nature orientation during adulthood. This is particularly important in the context of environmental inequities, especially in the cities where green is often unevenly distributed within cities, with reduced levels of vegetation for low-income, minority or other populations (Pham et al. 2012; Landry and Chakraborty 2009). This reduces opportunities for city dwellers to experience nature. However, orientations to go to urban green spaces are also of concern: indeed, despite existing cultural differences in landscape preferences and nature uses (Buijs, Elands, and Langers 2009), public policies sometimes also perpetuate the social exclusion of some minorities from green spaces they have access to. For instance, Byrne (Byrne 2012) observed that although Latinos are the numerically dominant ethno-racial group in Los Angeles, a relatively low proportion of them use a urban national park they have access to; further research then suggested that Latinos actually face ethno-racial and nativist barriers in accessing and using parks in the city, because of cultural histories of park-making and land-use systems (Byrne 2012). Landscape managers should therefore also consider providing green spaces access equally, to reduce environmental inequity.

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Study limitations

Our study suffers from some limitations, and any generalization to the French population must be done carefully. Notably, our sample was not random, because we surveyed people in five very different contexts. However, the complexity of the human society and individuals makes the selection of any representative sampling almost impossible for psychological surveys (Gobo 2006). So far, most psychological studies relied on specific groups of respondents, mostly university students, and can hardly be transferred to a more general audience. In the same way, our sample is not representative of the French population. However, we deliberately merged different sampled groups to increase the sample size, and to better approach representativeness of the French population. The strong consistency we found between the most quoted natural places among the five surveyed groups gives subsequent support to our strategy and strengthens our findings. In that sense, we are confident that our methodological strategy led to generalizable results, in the French cultural context. However, further research is needed to explore cultural differences in perception of natural places. It would not be surprising if, for example, North American respondents name different types of natural places, reflecting the differences in landscapes between United States and France. Finally, it would be interesting to explore whether people primarily visit natural places because of their accessibility, or because they appreciate those specific places.

Conclusions

To conclude, this study showed that, even if visited natural places are very diverse, there seems to be a common attraction to a few of these places, especially forests, which cover a large proportion of the French landscape. The degree to which people have experienced nature during childhood is a key determinant of whether they mostly visit forested or more urbanized areas at adulthood. This childhood experience of nature was also found to influence the frequency of visits of natural places during adulthood. Therefore, we suggest that nature experience during childhood is crucial to determine the likelihood of natural place visits during adulthood, but more importantly to determine the type of nature experience people could be looking for, either in forested or more urbanized natural areas.

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Finally, we found that the more people felt connected to nature, the less they needed to refer to a specific natural place, in other words that a high sense of connection to nature could lead to an appreciation of nature that is detached from any particular natural place. This study has implications regarding the extinction of nature experience. We encourage environmental educators to diversify as much as possible the natural places they use for their activities, to show participants that one activity does not belong to one specific natural place, and thus to encourage people to visit various places. We also encourage landscape managers to consider equally increasing for the population the accessibility and attractiveness of some natural places for recreational and restorative activities, in order to increase people's orientations toward nature, from a young age.

Supporting Information

The ranks of the quoted natural areas for each surveyed group (Appendix S1) are available online. The authors are solely responsible for the content and functionality of these materials. Queries (other than absence of the material) should be directed to the corresponding author.

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We wish to thank R. Mathevet and M.-X. Truong for allowing us to use some of the data they collected, but not analyzed. We also thank S. Ferreira, the director of the Zoological Park of Paris, and R. Simon, the director of the Reserve de la Haute-Touche, for allowing us to collect data within their zoos.

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Appendix A: Ranks of quoted places mentioned by at least 10 respondents, for each group. Numbers of quotes are in italics between brackets (e.g. “forest” is the most cited place for students, followed by “park”, and so on). Quoted places are translated from French quotes (in italics in brackets).

Natural places (<i>French quotes</i>)	Student	Adopter	Web	WoW	Zoo
Forest (<i>forêt</i>)	1 (<i>433</i>)	1 (<i>664</i>)	1 (<i>109</i>)	1 (<i>292</i>)	1 (<i>121</i>)
Park (<i>parc</i>)	2 (<i>150</i>)	2 (<i>496</i>)	4 (<i>26</i>)	2 (<i>223</i>)	3 (<i>78</i>)
Countryside (<i>campagne</i>)	5 (<i>111</i>)	3 (<i>344</i>)	5 (<i>23</i>)	5 (<i>65</i>)	2 (<i>87</i>)
Mountain (<i>montagne</i>)	4 (<i>135</i>)	4 (<i>305</i>)	8 (<i>10</i>)	6 (<i>45</i>)	6 (<i>17</i>)
Garden (<i>jardin</i>)	6 (<i>57</i>)	6 (<i>207</i>)	2 (<i>28</i>)	3 (<i>153</i>)	7 (<i>15</i>)
Sea (<i>mer</i>)	3 (<i>139</i>)	5 (<i>241</i>)	(<i>8</i>)	16 (<i>14</i>)	8 (<i>13</i>)
Woodland (<i>bois</i>)	8 (<i>24</i>)	7 (<i>179</i>)	6 (<i>11</i>)	8 (<i>44</i>)	4 (<i>23</i>)
Beach (<i>plage</i>)	7 (<i>47</i>)	12 (<i>75</i>)	(<i>8</i>)	10 (<i>36</i>)	(<i>5</i>)
Zoo (<i>zoo</i>)	(<i>4</i>)	8 (<i>139</i>)	(<i>2</i>)	(<i>7</i>)	10 (<i>10</i>)
Public garden (<i>jardin public</i>)	(<i>9</i>)	10 (<i>84</i>)	(<i>6</i>)	11 (<i>25</i>)	5 (<i>23</i>)
Fields (<i>champs</i>)	11 (<i>17</i>)	15 (<i>31</i>)	(<i>9</i>)	4 (<i>68</i>)	(<i>7</i>)
Vincennes' wood (<i>bois de Vincennes</i>)	(<i>5</i>)	9 (<i>87</i>)	(<i>3</i>)	(<i>8</i>)	9 (<i>11</i>)
Sea side (<i>bord de mer</i>)	(<i>6</i>)	11 (<i>84</i>)	(<i>6</i>)	(<i>5</i>)	(<i>6</i>)
Lake (<i>lac</i>)	15 (<i>10</i>)	13 (<i>40</i>)	(<i>3</i>)	12 (<i>24</i>)	(<i>6</i>)
River (<i>rivière</i>)	10 (<i>18</i>)	18 (<i>17</i>)	(<i>2</i>)	13 (<i>18</i>)	(<i>1</i>)
Urban park (<i>parc urbain</i>)	(<i>2</i>)	(<i>8</i>)	3 (<i>27</i>)	(<i>3</i>)	11 (<i>10</i>)

Study sites

Study sites

Study sites

1. French context of natural areas

France

The French territory is covered by a large proportion of agricultural areas (about 60%), while forests and semi-natural areas cover 34% of the territory, and 6% corresponds to artificial surfaces (lands dedicated to anthropogenic activities) (Fig. 4). Wetlands and water bodies represent about 1% of French territory. Those proportions were globally stable between 1990 and 2012 (MEDDE 2015).

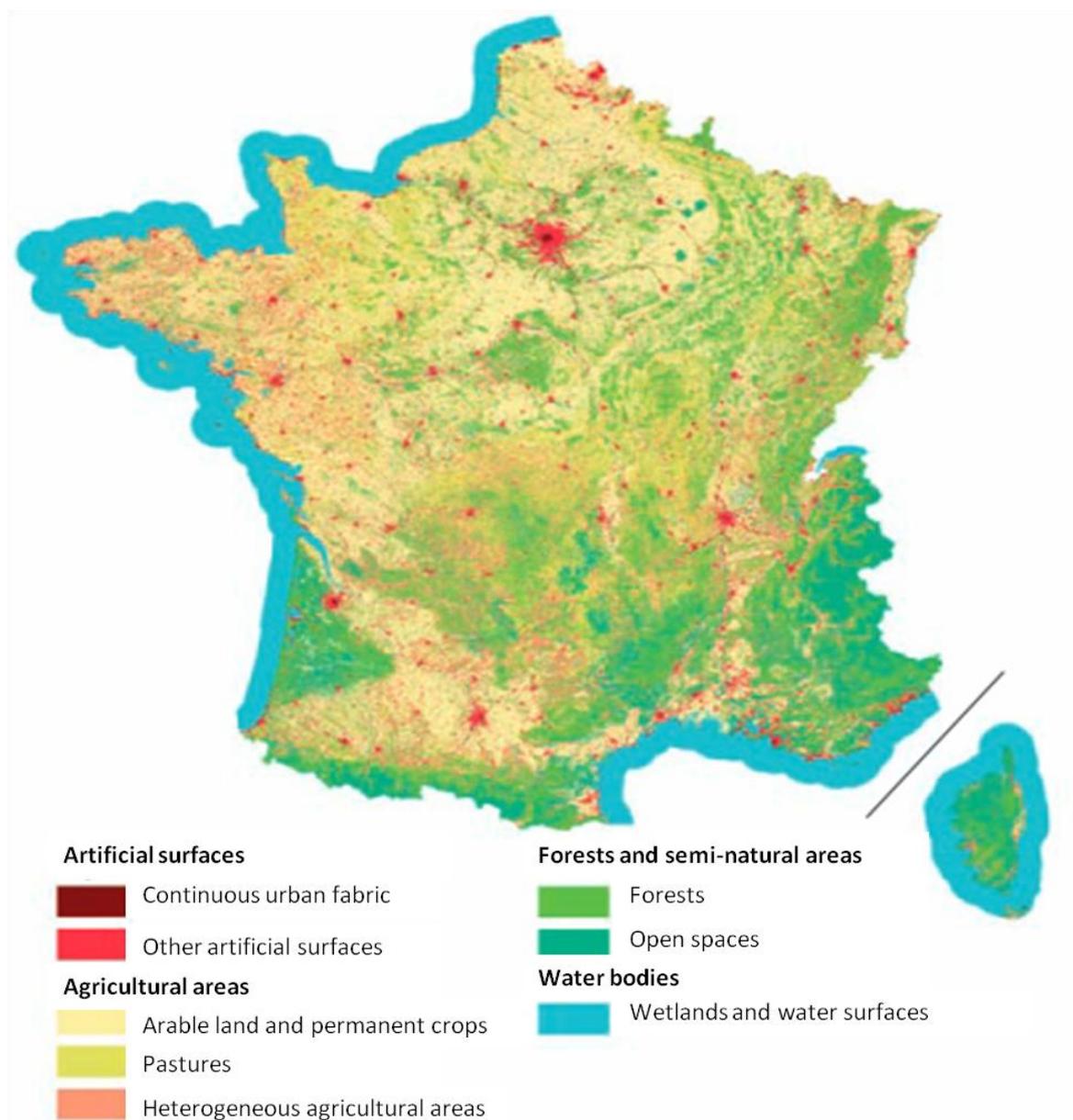


Figure 4: Land cover in France in 2012 (taken from MEDDE 2015).

Study sites

Paris

Paris is one of the most densely-populated metropolises in Europe. Green infrastructures in Paris consist of two large parks (about 1000 ha) at the periphery of the city, 17 medium-size parks (5-15 ha), over 400 small public gardens (0.1-5.0 ha) and 800 ha of private greenspace (APUR 2010). Thus, Paris has in total about 3000 ha of green infrastructures, for more than 9 million inhabitants, i.e. 14.5 m² or 5.8 m² per inhabitant, depending on whether the two large parks are considered or not. This amount of green spaces per inhabitant in Paris is relatively low compared to other European cities like Amsterdam (36 m² per inhabitant), London (45 m²), Brussels (59 m²), Madrid (68 m²), Vienna (131 m²) or Roma (321 m²) (APUR 2004).

2. Study sites

a. Zoos

To explore the potential of reconnecting people with nature and conservation issues, we focused on three zoos belonging to the French National Museum of Natural History. The Museum is a national institution with several missions, and the different sites owned by the Museum are dedicated to education, conservation, and research. The three zoos of the Museum (i.e. Menagerie of Jardin des Plantes, Paris Zoological Park, and the Reserve de la Haute-Touche), differ in size, location and animal collection (fig. 5). Data collection was thus conducted in these three sites, to explore our broad research question within different zoo contexts, and to identify possible differences related to their specificity.

Study sites

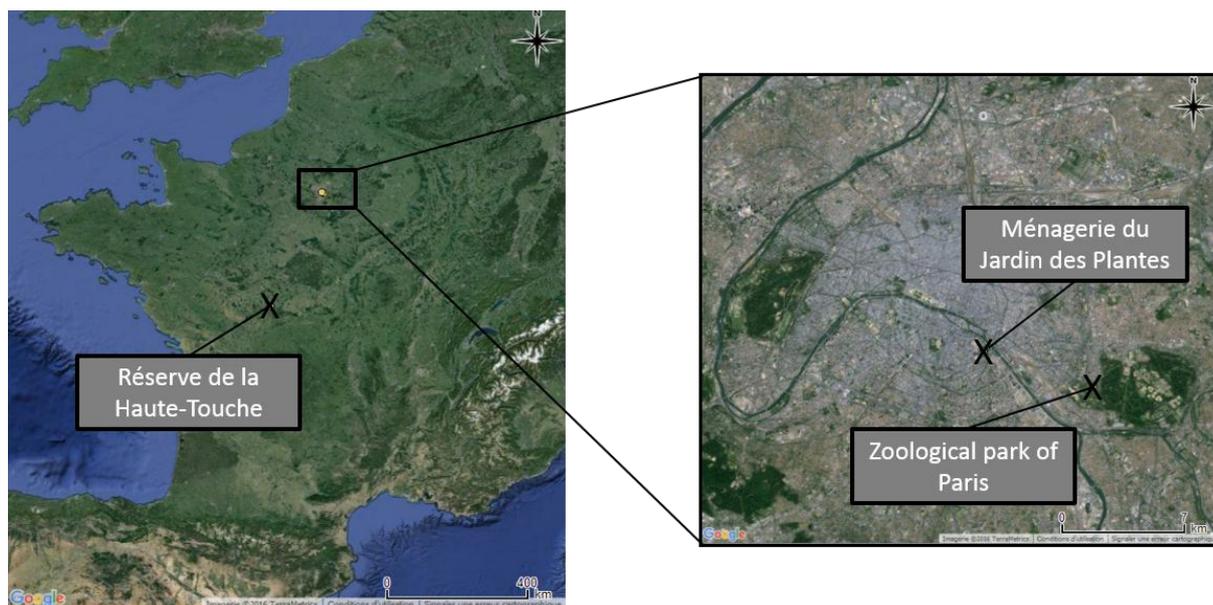


Figure 5: Aerial photographs of the three study sites: Menagerie du Jardin des Plantes and Zoological park of Paris, in the Parisian metropole, and Reserve de la Haute-Touche in the countryside in France.

i. Menagerie of Jardin des Plantes⁴

The Menagerie is the second oldest zoo existing in the world, after the zoo of Schönbrunn in Vienna. As a legacy from the French revolution, the zoo of the “Jardin des Plantes” was officially opened on 11 December 1794 by Étienne Geoffroy Saint-Hilaire, professor of zoology at the Museum. Across two centuries, the Menagerie knew successive periods of great popularity and less favorable moments, to turn gradually in meeting the current challenges of a modern zoo. Throughout its history, it sheltered all animal species ever presented in captivity, including now extinct species as the Quagga (*Equus quagga quagga*) and the Thylacine (*Thylacinus cynocephalus*).

The Menagerie of Paris is a unique architectural heritage (Fig. 6 and 7). The long history of the zoo is part of its buildings; all classified as historical monuments by the French Ministry of Culture in 1993. In the 1980s, a policy for the rehabilitation of the Menagerie was created,

⁴ Information retrieved from Derex (2012), the zoo website <http://www.zooudujardindesplantes.fr/> and personal communication with Michel Saint Jalme, the director of the zoo.

Study sites

with several successive renovations and a net preference for the presentation of small and medium size animals that are generally rare and endangered. The largest species (e.g. elephant, giraffe, lion, tiger, bear...) which were impossible to maintain properly in small facilities gradually left the Menagerie between 1970 and 2004. During renovation of the buildings and enclosures, cages were enlarged and intensely vegetated, wherever possible.

Nowadays, the Menagerie houses 1200 animals of 180 species on 5.5 ha (fig. 8): about 50 species of mammals, 70 species of birds, 40 species of reptiles, 10 species of amphibians and 10 species of arthropods (insects, crustaceans and spiders). The zoo of the Jardin des Plantes is located inside this well-know botanical garden belonging to the French National Museum of Natural History in Paris. Its location in the Museum implies that the visit of the Menagerie can be associated with the visit of others exhibits of the Museum. A large amount of vegetation can be found in the Menagerie, with 400 large trees and more spontaneous vegetation. As a consequence, and because of food availability, an urban fauna (mostly avifauna) can be observed in the zoo as well (e.g. pigeons *Columba livia*, blackbirds *Turdus merula*, or crows *Corvus corone*).

The Menagerie is a member of the European Association of Zoos and Aquariums (EAZA) and has three essential, interrelated missions: biodiversity conservation, research, and public education and awareness. As part of the Museum of Natural History of Paris, this zoo particularly develops research (population genetics, behavioral enrichment, reproductive biology, restoration ecology, veterinary sciences...) and educational programs. School classes represent 15% of their visitors. Guided tours and educational programs attract more than 800 school classes a year. The Menagerie received 650 000 visitors in 2014.

Study sites



Figure 6: Indian elephant at the Menagerie. Photo credit: MNHN – Bibliothèque centrale.



Figure 7: External view of the Big cat house. Photo credit: MNHN – Manuel Cohen.

Study sites



Figure 8: Aerial photograph and boundaries of the Menagerie of Jardin des Plantes (MJP).

ii. Zoological park of Paris⁵

The Zoological park of Paris also has a long history in Parisians' memories. Indeed, it has been created in 1934, in order to present the large-bodied species of the Menagerie for which the enclosures were considered not large enough. This zoo is the most famous in Paris, and is popular throughout France and even Europe. A giant roc artificially created to hide a water supply became the symbol of the zoo and contributed to its attractiveness.

At the time of its creation, there was already a growing concern for animal welfare, so the zoo was designed with larger enclosures than in the Menagerie, which was also allowed by the larger size of the zoo (14.5 hectares). However, because of the progressive degradation of the zoo, it has been closed for renovation in 2008 and reopened to the public in 2014 with a new concept based on an immersive journey into 5 biozones (Patagonia, Sahel-Sudan,

⁵ Information retrieved from Derex (2012), the zoo website <https://www.parczoologiqueparis.fr/fr> and personal communication with Michel Saint Jalme, the director of the Menagerie.

Study sites

Europe, Guyana and Madagascar), including a tropical greenhouse (Fig. 9 and 10), each of them dedicated to large ecosystems of the world. Enclosures were enlarged and physical barriers separating visitors from the displayed animals were reduced as much as possible, or hidden when it could not be removed. Glasses were used to give the visitor the impression to share the same environment as the displayed animal. PZP now hosts 2000 animals of 180 different species, including 42 species of mammals, 74 species of birds, 21 species of reptiles, 17 species of amphibians and 15 species of fishes.

The zoo is located at the periphery of Paris, near a large urban park (fig. 11). Because of its recent renovation, the vegetation in the zoo is currently growing, but it still quite low compared to other zoos, such as the Menagerie.

The PZP, by belonging to the MNHN, contributes to conservation of threatened species, through captive breeding programs and support to in-situ conservation projects; it also offers the opportunity to a large audience to learn more about environmental issues, and what actions every citizen can take. Additionally, the PZP sensitizes visitors to the concept of shared space – between species, between animals and human beings – and to the fragile balance of natural environments. Finally, it also helps increase knowledge on biodiversity and provides more largely environmental education. They propose a wide range of guided tours and activities, to individual visitors or school groups.

The PZP received 1 200 000 visitors in 2014.

Study sites

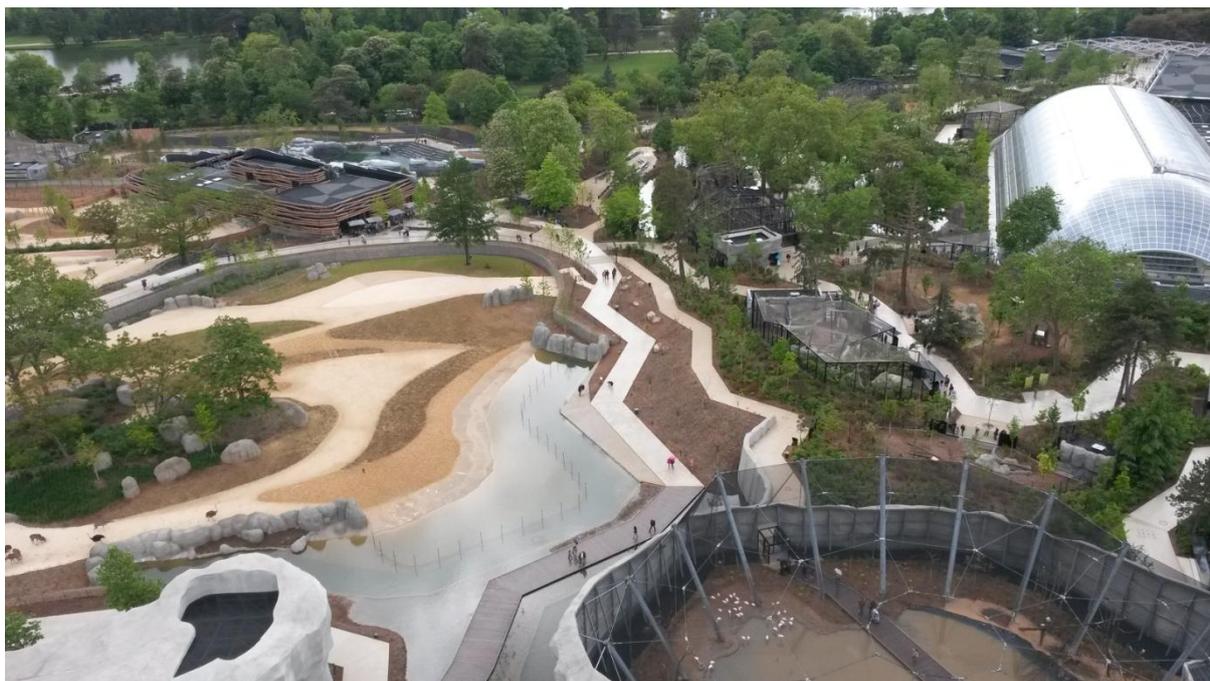


Figure 9: Overview of the zoo in May 2014. Photo credit: Agathe Colleony.



Figure 10: Madagascar biozone in the tropical greenhouse. Photo credit: MNHN – François Grandin.

Study sites



Figure 11: Aerial photograph and boundaries of the Paris Zoological Park.

iii. Reserve of Haute-Touche⁶

This third zoo is located in the countryside, four hours drive from Paris, and is more recent than the two previous ones. At first, the area of Haute-Touche was part of the Castle of Azay Le Ferron during the 15th century; then, in 1958, the Castle was offered to the city of Tours, and the Reserve was given to the MNHN, as a research center and a place where to keep surplus animals from the two Parisian zoos. It finally opened to the public in 1980, at the arrival of the European buffalos that were given as diplomatic gifts by the Polish prime minister to the French President.

The Reserve of Haute-Touche is located within a protected natural area, in a rural zone (fig. 12). This 500 hectares zoo from which 100 ha are opened to the public is the widest zoo in France and displays more than 1000 animals of 114 different species: 91 species of

⁶ Information retrieved from the zoo website <http://www.zodelahautetouche.fr/>

Study sites

mammals, 25 species of birds, and 4 species of reptiles. The Reserve houses one of the most diversified collection of deer in Europe (20 species and sub-species, 400 individuals). Animals, mostly large species of mammals, are presented in the natural local environment, mostly forested (fig. 13 and 14), since 90% of the Reserve is covered by vegetation. Visitors have the opportunity to rent bikes or bring their own and cycle within the Reserve (fig. 15).

The Reserve is the only French zoo that has the status of a research laboratory: their research projects mainly focus on applications for biotechnologies on reproduction, for conservation of threatened species (i.e. in-vitro fecundation, production of embryos and conservation of embryos through freezing process). They thus also manage a cryobank of sperm, embryos, and tissues, to preserve the reproductive capacity of extinct individuals. Additionally, they conduct veterinary studies (e.g. on pathologies), and numerous research projects on ethology, behavioral ecology and archeozoology.

The Reserve offers a wide range of educational activities and guided tours, to inform and sensitize the public to the environment in general. It also provides specific educational programs in professional cursus for zoo keepers, veterinaries and scholars.

The Réserve de la Haute Touche received about 50 000 visitors in 2014.

Study sites

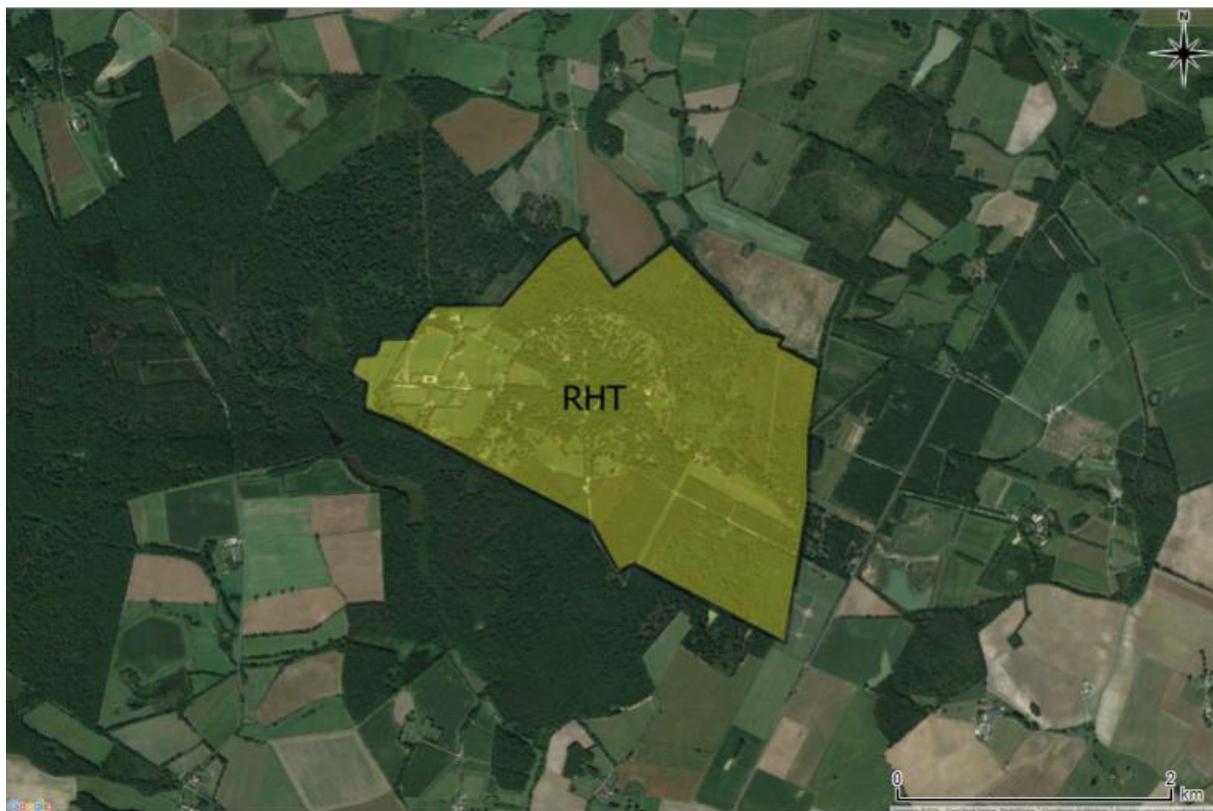


Figure 12: Aerial photograph and boundaries of the Reserve of Haute-Touche.



Figure 13: A deer exhibit at the Reserve of Haute-Touche. Visitors cross the exhibit by car, so that there is no physical barrier separating visitors from animals, except the car. Photo credit: Agathe Colleony

Study sites



Figure 14: Intersection within the zoo, with enclosures on both sides, and path continuing within the forest. Photo credit: Agathe Colleony



Figure 15: Visit of the Reserve by bike. Photo credit: MNHN – François Grandin.

Study sites

b. Urban parks

For comparison purposes, we also collected data from urban park users. Three urban parks of different size and location were selected within Paris: the first one is the so-called Jardin des Plantes, a botanical garden belonging to the Museum, and where the Menagerie is located. It is mostly composed of a wild and patrimonial collection of trees spread in a 12 ha Jardin à la française (Fig. 16). An “ecological” garden and a botanical school are also of particular interest for the visitors. There is only one localized and relatively small place of grass where people are allowed to sit in. The two other parks are Montsouris’ (Fig. 17) and Monceau’s parks (Fig. 18), located in the South and North West parts of Paris, respectively, and are owned and managed by the city of Paris. These 15 and 8 hectares parks, respectively, are each composed of a pond, large areas of grass where people are allowed to sit, and trees.



Figure 16: Jardin des Plantes. Photo credit: MNHN.

Study sites



Figure 17: Montsouris park.



Figure 18: Monceau park. Photo credit : Fiona Stewart.

Chapter 1:

What is a zoo visit experience? A preliminary study

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Chapter 1: What is a zoo visit experience? A preliminary study

Introduction

Before exploring the potential of zoos in reconnecting people with nature and conservation issues, it was necessary to investigate what the zoo visit experience is more precisely. Large research effort has already focused on the zoo visit, ranging from the exploration of its social and emotional components (Clayton, Fraser, and Saunders 2009; Fraser et al. 2009; Morgan and Hodgkinson 1999; Myers, Saunders, and Birjulin 2004; Reade and Waran 1996), the strong recreational aspect (Reade and Waran 1996) along with other dimensions like restorativeness (Pals et al. 2009), education (Moss, Jensen, and Gusset 2015; Moss, Jensen, and Gusset 2014; Moss, Jensen, and Gusset 2016; Esson and Moss 2013; Dierking et al. 2002) and conservation contributions (Balmford, Leader-Williams, and Green 1995; Carr and Cohen 2011; Delmas 2014; Fa et al. 2014; Gusset and Dick 2011; Martin et al. 2014; B. Miller et al. 2004). However, very few (only one of the previously mentioned) studies were conducted on French zoos, and most of them were conducted in the United States. Visitors' attendance, and thus popularity, nevertheless largely varies across countries, with more visitors in the United States and Japan, compared to other countries in the world (Davey 2007). Acknowledging the existence of cultural differences on landscape perception and preference (Herzog et al. 2000; Buijs, Elands, and Langers 2009), it is very likely that beliefs about zoos differ across cultures, and thus countries. Accordingly, a recent cross-cultural survey showed that descriptive and injunctive norms mediated the relationship between the perceived pro-environmental norm at the country level and the individual pro-environmental behavior, and that compared to a sample of Slovenian respondents (N=246), French respondents (N=215) appeared to be less sensitive to the indirect effect of the norm at the country level (Culiberg and Elgaaied-Gambier 2015).

Given that there is a strong lack of zoo-focused research in France, especially in conservation psychology, which is still relatively unknown in France, it appeared necessary to broadly explore the zoo visit experience in a French context, before investigating further the overall research question of this PhD project. In addition, the three surveyed zoos belong to the French National Museum of Natural History, a public institution, and thus may differ from other zoos that are private institutions. I therefore conducted a preliminary survey to broadly explore the zoo visit experience in the particular context of the three French zoos I

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focused on for this PhD project, to refine the research questions appropriately regarding the context. I explored visitors' motivations to visit zoos, perception of the animals, their wellbeing and their captivity, and perception of biodiversity conservation. I also assessed the consistency between the two terms "zoo" and "nature", to investigate whether visitors may consider the zoo as a place for experiences of nature, through various ways (e.g. captive animals, uncaged wildlife, vegetation). The answers to these questions could eventually help to examine the zoo's potential in reconnecting people with nature and biodiversity conservation issues.

Material and methods

Study sites

Data collection was performed in the three zoos of the French National Museum of Natural History (MNHN): (1) the Menagerie (MJP) is a small zoo (5.5 ha) established in 1794, located in the center of Paris, where approximately 1200 animals (170 species) are displayed by taxonomic groups, within relatively small enclosures or cages ; (2) the Zoological Park of Paris (PZP), is a larger zoo (14.5 ha) built in 1934, located in the suburb of Paris, which has been recently renovated (i.e. the zoo closed in 2008 for renovation and reopened in April 2014), and where 2000 animals (180 species) are shown in five different biozones, that evoke their natural environment ; (3) the Réserve de la Haute-Touche (RHT) is a recent rural zoo of 500 hectares (opened to the public in 1980), located in the center part of France, and where more than 1000 animals (114 species) are presented mostly within a forest landscape; visitors walk in a natural environment, but different from the original natural habitat of the animals in the wild.

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Method

Interviews of 38 groups of visitors were performed in the three zoos (12 in MJP, 9 in PZP and 17 in RHT), on different days and times, in April, May and August 2014. Nineteen of these groups were composed of adults with children. Two researchers performed the 15 first interviews together (in MJP and PZP) while for the other interviews, only one researcher remained. Two types of interviews were proposed to visitors: in the first one, the researcher did a part of the visit with the targeted group, while discussing with them about their feelings and impressions to gather information on their attitude toward the animals and toward others (“commented routes” (Thibaud 2001) – 14 interviews). In the second one, the researcher and the interviewees stayed at a specific point to answer all the questions and the interviewees continued the visit afterward on their own (“standing interviews” – 24 interviews).

All the conversations were recorded with visitors’ consent. The interviews lasted from 2 to 45 minutes, on average 10 minutes. They were informal but they all included questions on whether the interviewees were first time visitors or not, their motivation to go to the zoo, the frequency of their zoo visits, how they perceive the animals and the captivity, how much they experience nature on a daily routine, what they think about conservation of biodiversity (for a list of the principal questions, see Table 1).

Groups, ranging from one to six persons, were not chosen randomly. Rather, different types of groups (e.g. visitors on their own, couples, parents with children, grand-parents with children, groups of friends) were selected to be interviewed, since the purpose was to collect the most diverse answers as possible for this exploratory study. The different interviewees were approached at different locations in each zoo (i.e. 6 different locations in MJP, 6 in PZP and 8 in RHT).

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Table 1: List of the main questions asked to the visitors, in the three zoos. In some cases, the interviewee mentioned information before the related question was asked, leading the interviewer to adapt further questions. These questions were only guidelines during the interviews.

<p>Perception of the animals: habitat, well-being and captivity</p>	<p>What do you think about the conditions of the animals here?</p> <p>What do you think about captivity?</p> <p>Does looking at the animals in their enclosures make you think about their natural habitat and behavior in the wild?</p>
<p>Personal history with the zoo</p>	<p>Have you been here before?</p> <p>What brought you here today?</p> <p>Do you live around?</p> <p>How often do you visit zoos?</p> <p>Did you use to visit zoos with your parents during your childhood?</p>
<p>Natural areas' perception</p>	<p>Why do you go to natural areas?</p>
<p>Conservation attitude and behaviors</p>	<p>What do you think about conservation of nature and biodiversity?</p> <p>Do you care about it?</p> <p>Do you act toward it? If so, what do you do in a daily routine?</p>

Data preparation

Transcribed interviews were examined for the presence of recurring themes and for comments addressing our main research questions. Key themes were refined through discussions with PhD supervisors. All quotations are translated from French.

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Results and Discussion

We did not find noticeable differences between the two types of interviews and thus analyzed them similarly.

Linking conservation mission, captivity and the perception of animal well-being

Visitors have complex perceptions about animals being captive, in relation to the conservation mission of the zoos, perceived well-being of the animals, and perceived comfort of the visit itself.

Generally, the captivity was well perceived in the RHT (e.g. *“they are caged but they are still free”* Man, in his sixties, in the RHT). On the opposite, in Paris, many people criticized captivity (nine groups, mostly in MJP), but interestingly they seemed to justify the captivity with the conservation role of the zoo (seven groups, mostly in the MJP): according to them, animals are kept captive for their species’ own good, since it allows zoos to participate in conservation efforts and preserve species which would have disappeared otherwise.

“I think there are animals here which are preserved and which are endangered (...), so let’s say that it is a lesser evil (...) the fact that they don’t exist in the wild anymore is really sad, but at least if they are preserved in captivity, there may be a chance that one day they could be reintroduced into the wild” Woman, about 22, in the MJP.

Marseille and colleagues have categorized this value orientation as *ecocentric*, oriented toward the benefit of nature (i.e. captivity is well perceived because the visitor is convinced that zoo breeding programs will benefit the survival of the wild species) (Marseille, Elands, and van den Brink 2012).

The impact of captivity for animal welfare was also often pointed out (12 groups, in the three zoos, but mostly in the MJP). However, concern was mostly expressed toward big mammals, whereas no concern for species of reptilians or insects was mentioned at all (e.g. *“it’s easier for small mammals, rabbits, but we have less shame toward insects! (...) it depends on how we perceive their sensitivity; we perceive less sensitivity for an insect than for a dog”* Woman, on her thirties, in the RHT). Thus, some species seem to deserve more

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care and concern about wellbeing than others. These observations are consistent with those previously noted in the Biodome in Montreal (Estebanez 2006).

More generally, mammals have been repeatedly shown as being more likeable for conservation purposes than birds and amphibians (Tisdell, Wilson, and Nantha 2005). Yet, even if these factors tend to bias the choice of species presented to public in the zoos (Frynta et al. 2013), such emotional experience may positively impact people's general conservation awareness and attitudes (Allen 2002; Clayton, Fraser, and Saunders 2009; Kals, Schumacher, and Montada 1999; Marseille, Elands, and van den Brink 2012; Myers, Saunders, and Birjulin 2004). In some cases, emotional experience can reach such a degree that visitors impose their own perceptions on the animal. Indeed, a large number of examples of anthropomorphism were noticed in the zoos (10 groups, in the three zoos). A good example is this woman who was complaining about the lion being on his own in his enclosure, and who referred to her own perception of loneliness.

"We saw the lion, the poor one, on his own (...) thus a lion on his own, he is going to get really bored (...) I'd rather die, old but free rather than caged here on my own" Woman, in her forties, in the PZP.

Independently of the species, the relationship between captivity and animal welfare was often associated to the habitat present within the enclosure. More precisely, the size and the greenery level of the enclosures seemed to be determinant for the interviewed visitors, to rate the well-being of the animals, regardless of the natural habitat of the animal in the wild.

"I think they are doing well, they have everything needed here: they are free, they have grass (...) do you even realize? They have no chance to have a lodging like this one in the savanna, this isn't even possible! Yet, they are eaten by lions or cheetahs... then here, they are peaceful!" Man, on his fifties, in the RHT.

Such results have been previously found in Paignton Zoo Environmental Park (UK), where all participants rated the greenest enclosure highly, with the best perceived welfare for the caged individuals (Melfi, McCormick, and Gibbs 2004). However, the support for a wild-like

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setting can conflict with the goal of seeing the animals. Indeed, in the PZP, which was designed such a way (immersive manner), a large number of the interviewees mentioned the importance of being able to easily see the animal, which might not be possible in case of a large and highly vegetated enclosure where the animal can hide. These contradictory attitudes can often be observed in zoogoers, who both expect to see all the animals in the zoo, sometimes as easily as possible, and are bothered by captivity in terms of well-being of the animals. Although people complain about captivity, they still visit zoos and expect to observe animals.

Zoo visit for education purposes

The three studied zoos display many educative and informative signs. Some of them give very general information on conservation topics, and others are dedicated to presented species, giving information on the biology of the species and its IUCN Red list level of threat. The attention given to the informative signs was discussed with 14 groups (in the three zoos): four of them spontaneously admitted not looking at the informative signs; ten groups mentioned reading the signs, of which two groups had actually been observed paying attention to the signs. However, consistently with Clayton and colleagues' observation, previous observations of visitors' attention to the signs revealed that only 11.5% of them used the signs (Clayton et al., 2009 ; unpublished data from the author, 2014). Some visitors even mentioned not looking at the signs because they already knew the information, due to their strong experience of zoos (e.g. *"it is interesting to learn information on the animals, but since we've used to come often, we already know the park"* Man, in his sixties, in the PZP). However, those who read the signs seemed to be mostly interested in the name of the species and its geographical origin (four groups, in the PZP and the RHT).

"I like to read the informative signs, because sometimes we don't know the origin, and we want to know which country or continent the animal comes from, so it is interesting!" Man, in his sixties, in the PZP.

Despite a noticeable interest of visitors for the geographical origin of the species, we surprisingly observed a biased perception of which habitat is natural for some species. For

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instance, three groups of the RHT visitors considered that exposed animals were in their natural habitat although they were presented in a European forest.

“Even the tigers, they really are in their element!” Man, in his fifties, in the RHT, speaking of the tigers presented in small enclosures within a European forest.

Personal history with the zoo

In the targeted zoos, many people had strong memories of visiting the zoo with family members during childhood (ten groups out of 38, in the three zoos), which may have led them to reproduce these social experiences with their own children when becoming parents, or even grandparents.

“I do know that I used to come with my parents when I was a child, today we brought our children, and that’s it! It contributes to a cycle!” Man, in his fifties, in the MJP.

Some visitors mentioned that they enjoyed the visit during their childhood and so wished to come back to either a particular zoo they really remembered and liked, or to zoos in general. Thus the memory of the zoo visit becomes important in defining their sense of themselves. More precisely, the memory is linked either to a specific zoo (e.g. a woman narrated her experiences of visits in the MJP during her childhood, with the bear enclosure, which now contains small mammals, when she and the interviewer approached the mentioned area) or to the zoo visit in general, regardless of the zoo visited: a nice experience of a zoo may lead people to visit another one afterward. This is particularly true in the MJP and the PZP, which have a long history. Visitors with a previous experience of the zoo are likely to remember previous events while doing the actual zoo visit, which reactivate the memory.

“I do remember the short rides on the dromedaries’ back that they used to bring us to, and I do remember that I cried, cried, I didn’t want to ride on this huge beast, poor animal ... here they are well, the giraffes are well, this is splendid, it has been well renovated!” Woman, in her sixties, in the PZP.

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This attachment had also been observed toward particular individual animals, especially for visitors with a past experience of the zoo. For instance, referring to the recent transfer of a particular jaguar from the MJP where he spent two years, to the PZP, a woman complained that the PZP was *“stealing all of [her] favorites from [her]”* (Woman, in her thirties, in the MJP). Another good example is Nénette, the famous Orangutan in the MJP that is present in the zoo for many years and has been the hero of a recent movie.

“And often, the Menagerie, this is to visit Nénette ! (...) she is the one ... I mean she arrived in France almost when I was born, thus, she is a reference (...) she is very very old! (...) she is older than me!” Woman, in her fifties, in the PZP.

In relation to the attachment to the zoo visit for some family groups and the desire for parents to pass experiences or values on to their children, sixteen of the 19 groups with children reported going to the zoo specifically FOR their children. Two more groups without children mentioned that the zoo visit is mostly dedicated to children. Four groups of visitors (from the three zoos) said that they just followed their children’s decisions and wishes within the zoo.

“He loves everything about animals, so (...) we can say that I just follow him” Man, in his forties, in the RHT.

In contrast, a few people affirmed that if children were the main reason why they went to the zoo, it was also for them, as adults, a way to experience nature (15 groups in the three zoos, mainly in the RHT). For instance, a woman who visited the RHT *“not for [her], but for the children”*, mentioned that if she did the visit without the children, *“at most, [she] could go there for a nice walk”*. Another woman explained that the zoo visit was for her children, together for an enjoyable walk for her, in the forested area of the RHT:

“This is more for the kids! But at the same time, I walk around (...) I do like walking in the forest! And here, we have even the chance to observe animals, so...” Woman, in her thirties, in the RHT.

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The perception of the educational function of the zoo, especially toward children, could therefore provide people a reason to go to the zoo, but then their experience might differ from the initial purpose.

Zoo as a natural area

To investigate the potential of zoos perceived as an experience of nature, we explored the visitors' perception of natural areas, through their motives to visit such places. Surprisingly, some visitors mentioned the impossibility to observe wildlife in cities, and others mainly indicated rural places for the natural places they visit (10 groups in the three zoos). For these individuals, being in contact with nature and encountering wildlife is necessarily outside of cities. Thus, these individuals did not seem to perceive the ordinary biodiversity present in cities.

"I do like animals, except than we cannot observe them into the wild in Paris, so it is good to come here instead" Woman, about 22, in the MJP.

Although no questions about restorative aspects of nature were asked to the visitors, many of them spontaneously mentioned the restorative aspects of nature as reasons for appreciating natural places (17 groups in the three zoos). More precisely, we found some of the characteristics of restorative places proposed by Kaplan and Kaplan in our study: *fascination* (i.e. when fascinated, people's attention is effortless), *extent* (i.e. cognitive map that individuals have of an environment) and *being away* (i.e. escape from your everyday environment) (Kaplan and Kaplan 1989). Indeed, animals are fascinating (e.g. *"animals have always been fascinating"* Man, in his sixties, in the RHT); then, people with a previous experience in the zoo already know the park and how to orientate when they come back (e.g. a woman who used to come very often to the MJP with her child, and mentioned the place they systematically visit first in the zoo, and the following areas they visit or avoid; unrecorded interview); finally, many individuals referred to the *being away* characteristic of the zoo (e.g. *"we avoid Paris, by being here"* Woman, in her fifties, in the MJP, so within the middle of Paris).

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Surprisingly, the zoo visit is sometimes not presented by visitors as the occasion to encounter something (animals, nature, etc.), but as a way to escape from something: city noise (e.g. car traffic noise, two groups in the MJP and the RHT), built-up (13 groups, in the three zoos) or crowd (nine groups, in the three zoos but mainly in the RHT). Therefore, the zoo could also be perceived as a natural place simply because the zoo visit is a way to escape from urban settings or daily routine.

“What we like is like here, to be able to walk in nature, forgetting that there are other people around, and (...) we feel like we are on our own!” Woman, in her sixties, in the RHT.

Conservation attitude and behaviors of zoo visitors

When asked, all zoo visitors mentioned caring about conservation of biodiversity and nature, either for aesthetics, restorative or utilitarian aspects of nature. These categories have been defined during the analyzing process of the interviews, categorizing comments about the liking or necessity to preserve nature or biodiversity because of (1) its beauty as the *aesthetic motive*, (2) all the goods nature or biodiversity provides in terms of well-being as the *restorative motive*, and (3) the edible materials nature or biodiversity provides to people as the *utilitarian motive*. However, when asked if they do act toward biodiversity or nature, the most quoted actions were waste avoidance, recycling, education and local/organic food consumption (see tab.2). Independently, some visitors highlighted the fact that they could not do anything since they live in cities or do not own a garden (two groups in MJP and PZP, and one group in MJP who mentioned acting for biodiversity conservation specifically because they garden).

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Table 2: List of quoted ecological behaviors, with respective number of quotes and locations. MJP= Menagerie; PZP= Zoological park of Paris; RHT= Réserve de la Haute-Touche. Behaviors were listed in the table if they were mentioned at least once during all the interviews, and appeared in previous scientific literature (Kaiser et al. 2003).

Number of quotes	Behavior	Zoo
8	Do not litter	MJP, PZP and mostly RHT
7	Recycle	MJP, PZP and RHT
5	Educate	MJP, PZP and RHT
4	Eat local and/or organic food	MJP, PZP and RHT
2	Do not waste water	MJP
2	Turn off the lights	MJP
2	Do not use pesticides	MJP and RHT
1	Take public transportation	MJP
1	Support environmental organizations	RHT
1	Compost	MJP

Therefore, there seemed to be a shared belief, among the interviewed zoo visitors, that waste avoidance, recycling, education and local/organic food consumption are beneficial for nature or biodiversity. However, a few other actions were only mentioned by one or two groups, suggesting that fewer people either acknowledge or perform these actions. Recent research showed that most zoo visitors were willing to, and do learn more about actions they can incorporate in their daily lives to contribute to conservation (K. Roe, McConney, and Mansfield 2014; Moss, Jensen, and Gusset 2015).

In addition, some visitors surprisingly considered conservation as activism or at least as a very engaging process, which they are not part of (nine groups in the MJP and mostly the RHT). Therefore, it really seemed that for them, action is good, but is someone else's job, either activists or governments, and that common citizen cannot do simple actions to preserve biodiversity.

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Conclusion:

This preliminary study revealed different complementary aspects of the zoo visit. First, we found a strong attachment of some visitors, which was mostly linked to visitors' past experiences with the place. This attachment was not only dedicated to animals and zoos, but also to the "*zoo experience*" since many visitors have integrated the zoo visit as an important part of their childhood experience, and seemed to reproduce this scheme with their own children when becoming parents. Our results indicate also that captivity is a matter of concern for most visitors, who however often use the largely acknowledged conservation mission to justify it. Nonetheless, although caring about the animals' wellbeing, zoo visitors still expect to be easily able to see the animals. A first inconsistency can thus be noted here, between the perception of captivity and the desire to see the animals. Although the conservation mission of the zoo was largely recognized and zoo visitors seemed to care about biodiversity conservation, caring about biodiversity conservation did not necessarily imply active conservation behaviors. A second inconsistency can thus be noticed here, between support for conservation and not acting. We suggest that this low involvement could result from a lack of knowledge about conservation actions. Together with Roe and colleagues (2014), we consequently suggest that zoo educational efforts focus on individual practices to achieve conservation goals more fully.

Oxarart and her colleagues reported that zoos have the potential to influence adults' knowledge and intentions to visit local natural areas with their family, through specific exhibits where children can play with natural elements, and adults increase their knowledge (Oxarart, Monroe, and Plate 2013). Based on these preliminary results, we further hypothesize that some people may already use the zoo as a natural place to visit, either for educational, recreational or restorative purposes.

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Chapter 2:

How do people perceive nature at the zoo?

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Introduction

We showed in the introduction (see manuscript 1) and in the previous chapter (preliminary study) that some people consider the zoo visit as an experience of nature, both directly and indirectly (through escape from urban settings). However, and surprisingly, little research effort has, to our knowledge, investigated the experience of nature that the zoo offers. Yet, zoos display captive animals, sometimes local species, but to a large extent more exotic species, in enclosures that are designed to evoke as much as possible the natural environment of the species in the wild (immersive landscape concept: Coe 1985). Vegetation is thus entirely installed and managed. Therefore, one type of nature the zoo offers to encounter is caged, artificially managed and exotic, whereas it is nowadays important to reconnect people with the nearby environment, or in other words, with more common and local biodiversity (Dearborn and Kark 2010; Couvet 2012). Savard et al. (2000) also noted that previous research showed that “personal exposure to natural things in everyday life is a major determinant of sensitivity to environmental issues” (p. 132) (Sebba 1991). In addition, the zoo may also strengthen the separation between humans and nature, through the physical barriers separating animals from visitors, and through the exoticism displayed at the zoo, rather than enhancing feeling of interconnection with nearby nature.

Nevertheless, besides the exotic animals and natural environment the zoo display, visitors can also experience another type of nature, since areas designed for visitors’ passage or presence are composed, to a large extent, of vegetation, very similar as what could be found in urban parks. Because the zoo is not physically isolated from the surrounding environment, there are urban species that can freely move in and out of the zoo. For instance, local birds, small mammals or insects can be observed in the zoo, although they are not part of the animal collection. Similarly, some vegetation can spontaneously grow in the zoo, through seed transport by the wind (anemochory) or animals and visitors (zoochory).

However, we know that repeated stimulations can lead to habituation, and thus to a possible non-response to this stimulus at some point (Harris 1943). Therefore, we could imagine that urban dwellers pay less attention to the urban biodiversity they have the possibility to encounter in their everyday lives. Indeed, we observed in the preliminary survey mentioned in chapter 1 that some people did not seem to perceive the urban biodiversity, and explained that the zoo was their only way to observe wild animals (i.e. not pets). Moreover, recent research showed that most Parisian urban dwellers do not even pay attention to feral pigeons (*Columba livia*), a very common bird in Paris (Skandrani et al. 2015). To share an anecdote with you, I once observed two retired woman

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laughing at a man in Paris' zoo because he was taking a picture of a bee: "*Pfff he is going to the zoo and he is taking pictures of bees*"! It seemed ridiculous for them to show interest on insects or uncaged wildlife in the zoo, most probably in comparison to all the caged species the zoo allowed to encounter. Therefore, it remains unsure whether people perceive or give credit to the urban biodiversity in zoos, especially because they have strong expectations toward caged animals.

We thus explored in this chapter what people perceived as "nature" in the zoo. Do they consider caged animals and their artificially created environment as nature? Do they even distinguish caged from uncaged wildlife? Do they include humans in their perception of nature in the zoo? Previous research indeed showed that some people consider themselves as part of the natural world, whereas others believe humans are separate or distinct from nature (Buijs et al. 2008). We investigated further these questions, by exploring the perception of nature in zoos from both visual and auditory perspectives. Much research has focused on the sight of a natural environment or element, or overall presence in a natural environment on restorativeness for instance (e.g. Bratman et al. 2015; Van den Berg, Jorgensen, and Wilson 2014). However, the experience of nature is a multisensory experience, as people can observe (e.g. sight of an animal), listen (e.g. animal vocalizations or wind in the trees), smell (e.g. animal rejection or aromatic plants), taste (e.g. fruits) and touch (e.g. soil) the natural world. Growing research effort has explored the perception of soundscape of natural environments, mostly in urban parks, whereas none, to our knowledge, has assessed soundscape and its perception in zoos.

We therefore investigated in the third manuscript what people perceive as "nature" in the zoo, through the content analysis of photographs taken by visitors in the zoo, illustrating "nature"; this manuscript is *in preparation*, and supplementary data will be added and explored soon.

In the fourth manuscript, we explored the soundscape in zoos, and more precisely the perception of natural and human sounds, through an anthropological method.

Manuscript 2

Manuscript 2.

What does “nature” mean at the zoo?

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In preparation

Manuscript 2

Introduction

Together with the on-going biodiversity crisis, the increasing urbanization progressively diminished people's opportunities to directly be in contact with nature, and willingness to do so. This has been termed the "extinction of experience", first by Pyle (1978), and then more recently by Miller (2005) and Soga and Gaston (2016). However, experiences of nature offer a wide range of benefits, from the improvement of individual health (Mitchell and Popham 2008), well-being (Howell et al. 2011) and attention restoration (Kaplan and Kaplan 1989), to the encouragement of conservation attitudes and behaviors (J. R. Miller 2005). In urban settings, where people may particularly lack opportunities to experience nature, various settings are implemented to offer such opportunities: private and community gardens, urban parks, informal urban greenspaces (e.g. vacant lots, street or railway verges and riverbanks), or zoos. Rupprecht et al. (2015) recently stressed that urban parks and gardens may not fulfill the diverse nature needs of the growing global urban populations, mainly because they mostly provide structured recreation and nature contacts, in comparison to informal urban greenspaces that provide more unstructured nature contacts.

Zoos are institutional places that can be found worldwide, and that attract huge amounts of visitors (Gusset and Dick 2011), mostly for recreational purposes (Reade and Waran 1996). They offer people the opportunity to observe wild animals, and their recreated natural environment. This therefore places visitors in a "natural" environment, either local or more exotic. However, zoos offer a particular view of nature, offering structured recreation and nature contacts, since the "natural elements" displayed at the zoo are entirely installed and managed; in addition, zoos mostly display exotic species, and thus emphasize an "exotic" nature, rather than the "nature" people can experience (or not) in their daily lives. Ballouard et al. (2011) showed that the sample of French children they surveyed had a higher level of knowledge of exotic and charismatic species and were more prone to protect them, in comparison to local animal species. This is striking, as it is nowadays crucial to develop conservation consciousness and concerns about local biodiversity, since it directly contributes to the material and social components of human well-being, to the sustainable maintenance of provisioning services (i.e. the benefits people obtain from ecosystems, including food, water, timber and fiber (MEA 2005)), and to the preservation of threatened

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species (Couvet 2012). Complementarily, by showing caged species, zoos could reinforce the separation between humans and nature, instead of increasing people's sense of belonging to the natural world.

However, zoos also host a great deal of urban free-ranging species, mostly birds, which come to the zoo to feed for instance (Colleony et al. [manuscript 3]). The zoo visit could thus offer the opportunity for visitors to encounter urban species, as in urban parks. Nevertheless, recent research has shown that very common species are barely perceived by the public, either in the street (Skandrani et al. 2015) or in urban parks (Shwartz et al. 2013).

More research is therefore needed for a better understanding of people's perception of nature in zoos. Representations of nature or biodiversity (Buijs et al. 2008; Buijs 2009), and landscape preferences (Balling and Falk 1982; Han 2010; Herzog et al. 2000) have been largely explored, through qualitative methods like focus groups (e.g. Buijs et al. 2008), or quantitative ones through analysis of drawings (Barraza 1999; Yilmaz, Kubiak, and Topal 2012) or presentations of landscape photographs to participants (e.g. Balling and Falk 1982). Meanwhile, people share nowadays billions of photographs in different online communities (Peppler 2013 in Vartiainen and Enkenberg 2014), to share their travel experiences for instance (Stepchenkova and Zhan 2013) thanks to digital cameras that are included in most phones, laptops and other devices that people carry with them. Thus, photography has also been used as a research method, either as a *tool*, or as a proper *object*. When used as a tool, photographs are usually taken or selected by the researcher, who shows then to participants that are supposed to express their preference for instance (e.g. Balling and Falk 1982; Banks and Zeitlyn 2015). However, when used as a proper study object, participants take the photos, which are then analyzed by the researcher. Content of the photographs is thus decided by the respondents themselves, and directly reflects the respondents' personal representations (Petersen and Østergaard 2016). It has however never been used so far to explore landscape preferences or representation of nature. People's photographs of "nature" could be used as a proxy of their perception and preferences on the natural world. Indeed, it has been suggested that "children's drawings provide a 'window' in to their thoughts and feelings, mainly because they reflect an image of his/her own mind" (Thomas and J 1990 in Barraza 1999, p. 49-50) and Buchanan stressed that photography allows the

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“detailed recording of social reality, offering holistic representations of lifestyles and conditions” and can “capture and record complex scenes and processes” (Buchanan 2001, p. 152).

Therefore, the purpose of this study was first to explore what people perceive as “nature” in the zoo, through the content analysis of their photographs of what they consider as “nature” at the zoo. We hypothesized that zoo visitors would emphasize captive species, within their recreated habitat, and that little attention would be given to the urban biodiversity. Therefore, we tested whether zoo visitors emphasized captive species or if they included urban biodiversity, whether humans are included or not, and to what extent they consider the importance of vegetation in their representation of “nature” at the zoo. Second, we focused on perception of animals, to compare whether participants’ pictures of animals globally follow the same pattern as the animal collection at the zoo (e.g. if a majority of mammals at the zoo, is there a majority of mammals on the pictures too?), and whether participants took pictures of the animals people generally expect to see at the zoo or took pictures of different animals (*soon included in the manuscript*). Finally, we looked at how participants perceived nature and the animals at the zoo, through the analysis of captions of photographs.

Method

Study sites

We collected data within two zoos owned by the French National Museum of Natural History (MNHN): (1) the Menagerie (MJP) is a small zoo (5.5 ha) established in 1794, located in the center of Paris, and which hosts approximately 1200 animals of 180 different species; it is located within a large botanical garden, and contains an important amount of vegetation; (2) the Zoological Park of Paris (PZP) is a larger zoo (14.5 ha) built in 1934, located in the suburb of Paris, which was closed for several years (2008-2014) for renovation and opened recently as an immersive zoo; it now displays 2000 animals of 180 different species in five distinguished biozones (Patagonia, Sahel-Sudan, Europe, Guyana and Madagascar). These

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two zoos were selected in order to survey a large sample of diverse people visiting different types of zoos, since the two zoos differ in size and type of exhibits. Although the PZP contains a much lower amount of vegetation than the MJP due to the recent renovation, both zoos host urban – non-captive – species, mostly birds. For instance, the blackbird (*Turdus merula*), the feral pigeon (*Columba livia*), the common wood pigeon (*Columba palumbus*), the blue tit (*Cyanistes caeruleus*), the great tit (*Parus major*), the Eurasian wren (*Troglodytes troglodytes*), the Eurasian coot (*Fulica atra*), the common moorhen (*Gallinula chloropus*) and the carrion crow (*Corvus corone*) are common bird species that can be observed in the two zoos.

Survey instrument

In each zoo, we distributed 10 000 small leaflets to invite entering visitors to participate in the survey, in February 2015 and from July 2015 to February 2016. Leaflets displayed a picture of the zoo (a building for the Menagerie, and the famous rock for Paris' zoo) with the title "Nature at the zoo" on one side, and a brief invitation to participate in a research study, along with the link of an online questionnaire, and a QR code leading to the questionnaire as well, on the other side. To optimize the participation rate, we also informed participants that although it was not a photographic contest, there will be a random draw allowing participants to win free entrance tickets to the zoo. In total, 41 zoo visitors participated in the survey (13 in the MJP and 28 in the PZP).

We first asked respondents to take one to five pictures which best describe "nature" during their zoo visit, and to upload them at the beginning of the online questionnaire survey. We informed participants that it was not a photographic contest, but instead we invited participants to take photographs using cameras or even mobile phones. We indeed were not interested in rating the quality of the picture or style of the picture, but only its content. Participants were given the possibility to provide a caption for each of the pictures they uploaded. In total, we received 149 different pictures. Then, they were asked questions about their visit, their perception of nature in various places, their relationship to nature,

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and information on their demographics. We finally invited participants at the end of the questionnaire to provide an email address allowing us to contact them for the random draw.

Motivations for the zoo visit

We recorded the zoo visited by the participants, and their motives for the visit as an open ended question. We then recoded the motives into 5 categories that were defined in Colleony et al. [manuscript 4]: social (those looking for a social experience), self (those with personal expectations, like well-being), animal (those looking for the animal encounter), place (those looking for a visit of this particular place) and other (any other reason not fitting into previous categories).

Perception of nature in various places

Participants were asked to what extent they believe nature is present in a list of places (Amazonia, countryside, urban green space, personal garden, personal residence, forest and zoo) on a 4-point scale (0-not at all, 1-a little, 2-to some extent, 3-very much). A fifth option allowed them to indicate an absence of opinion.

Relationship to nature

Participants were asked to report their frequency of visits to natural places, on a 5-point scale (0-never, 1-A few times a year, 2-Once a month, 3-Once a week, 4-Every day), the levels of rurality of their place of residence and place of childhood, using a 5-point scale (1-Large city, 2-Medium sized city, 3-Small city, 4-Village, 5-Hamlet). We also measured participants' altruistic, egoistic and biospheric levels of environmental concern using Schultz' Environmental Motives scale (Schultz 2001). This measures the extent to which individuals are concerned about environmental problems because of the consequences that result from harming nature. Participants rated 12 items on a 5-point scale ranging from 1 (not important) to 5 (very important). Egoistic items are *me, my future, my health, and my lifestyle*; altruistic items are *future generations, humanity, my community, and children*; and biospheric items are *plants, animals, marine life and birds*.

Demographics

We recorded participants' gender and category of age (18-25, 26-30, 31-40, 41-50, 51-60, 61-70 and above 70) recoded as 1 to 7 for analysis.

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Content analysis of the pictures

We described each picture with 5 different variables, as following: we noted for each picture the amount of vegetation using a 3-point scale (0 for none, 1 presence of vegetation, but covering less than 50% of the picture, and 2 for presence of vegetation covering more than 50% of the picture). Additionally, we recorded the presence or absence of captive species, non-captive species, humans, and physical barriers on each photograph. Then, we computed 5 variables per participant, as following: for each participant, we calculated the average amount of vegetation in the pictures s/he uploaded, the proportion of pictures displaying captive species and of pictures showing non-captive species, and the proportion of pictures displaying the animal within his environment, compared to close-up pictures of animals. We also indicated for each participant the diversity of animals using a 4-point scale (0-none, 1-only one species, 2-different species of the same taxonomic group, 3-different species from different taxonomic groups). More precisely, we noted for each individual the proportion of pictures showing mammals, birds, reptiles or amphibians, arthropods, fishes, and vegetation solely, respectively.

Comparison with expectations of visitors toward animals at the zoo

Data will be soon included in the manuscript.

Analysis of the captions

The exploration of the overall content of the text of the captions, allowed us to extract main themes. Because it was not mandatory to provide captions to the pictures, we did not conduct a systematic analysis of their content. However, 31 (75 %) of the total participants provided captions, so we used the available captions as additional information that can provide more insight to what people consider as nature in the zoo.

Statistical analyses

We first described participants' demographics, and we compared the perception of nature in the different places listed in the questionnaire (i.e. Amazonia, countryside, personal garden, personal residence, zoo, and urban green space), and looked whether results were

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consistent between participants. We then looked at the overall numbers of pictures displaying each of the characteristics described above.

We conducted several statistical analyses attempting to explore possible determinants (relationship with nature, motive for visit and demographics) of characteristics of the pictures, but most results were not significant. The few significant results we found were only weakly significant. Thus, because our sample of respondents is very small, we cannot state whether results are not significant because there is no trend, or only because of lack of data. We therefore chose not to consider such analyses in this paper.

Results

Respondents' description

Participants were more women (48.8%) than men (34.1%); 7 did not specify their gender. Among participants who reported their age (N=33), most were 18-25 (21.2%) and 31-60 (69.7%) years old, while only two participants were 26-30 and one 61-70 years old. There was no significant difference between the two zoos in the rurality level of place of childhood and place of current residence (Fig. 1a and 1b; Kruskal-Wallis chi-squared test; childhood: $\chi=0.04$, $df=1$, $p=0.84$; current residence: $\chi=0.17$, $df=1$, $p=0.68$). However, respondents from PZP mentioned more regular visits to natural places than respondents from MJP (Fig. 1c; Kruskal-Wallis test: $\chi=4.18$, $df=1$, $p=0.04$).

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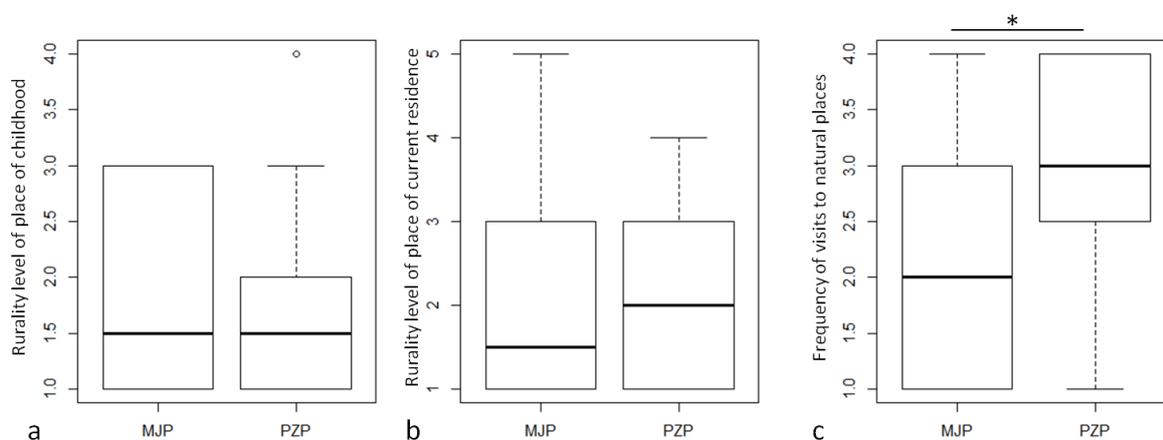


Figure 1: Comparison of respondents from both zoos in (a) rurality levels of place of childhood and (b) of place of current residence, and in (c) frequency of visits to natural places. MJP stands for Menagerie of Jardin des Plantes, and PZP for Paris Zoological Park. * stands for $p < 0.05$

Perceived naturalness of different listed settings

Exploration of the perceived naturalness of the different listed settings revealed large differences (Fig. 2). Indeed, Amazonia and the forest were the places where presence of nature is perceived as the higher, with relative agreement between respondents, while garden, urban green space and household were places where presence of nature is perceived as much lower, but with large variation between respondents. Presence of nature was perceived as significantly lower in zoos than in Amazonia (Wilcoxon tests; $W=364.5$, $p<0.001$) and forest ($W=366.5$, $p<0.001$), but significantly higher in zoos than in garden ($W=755$, $p=0.013$), urban green space ($W=1006$, $p<0.001$) and household ($W=1076.5$, $p<0.001$).

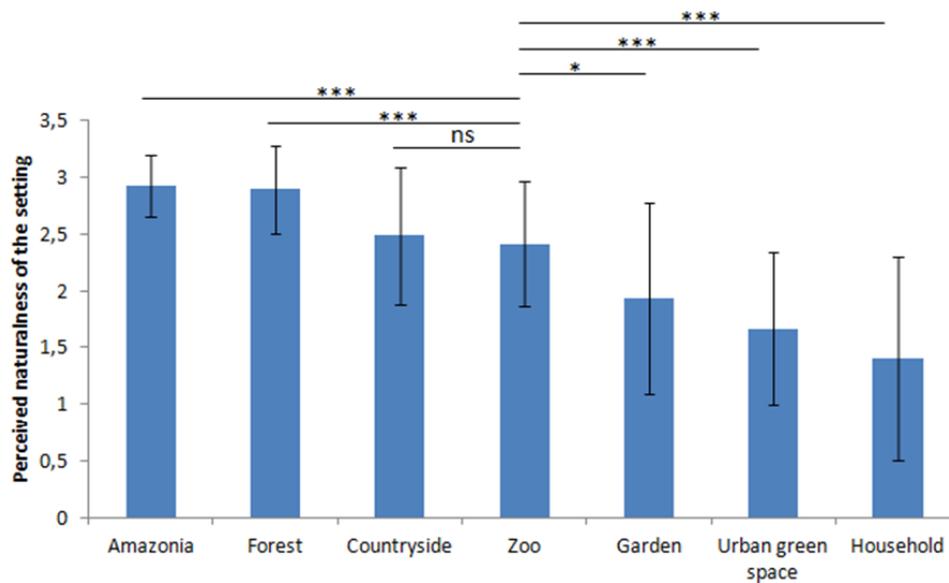


Figure 2: Average perceived naturalness of different places, and variation among respondents shown through error bars. Levels of significance of differences with zoo are shown, using Wilcoxon tests (ns: non-significant; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$).

Content analysis of the pictures

We noted that among the 149 different pictures, 127 displayed captive animals, whereas only 4 displayed non-captive species. The 18 remaining pictures showed vegetation or landscape solely (e.g. Fig. 4). The human presence was noticeable in only 5 pictures (e.g. Fig.5), of which 4 pictures were landscape views of the zoo in which visitors could be noticed and only one picture seemed to intentionally include a human being. The presence of fences or artificial elements clearly showing captivity was observed in 30 pictures, although it is important to note that participants clearly made efforts to take pictures devoid of fences. In addition, 73 of the 131 pictures of animals also considered their surrounding environment (e.g. Fig. 6), compared to 58 close-up pictures of animals (e.g. Fig. 7).

Many participants (N=26) took pictures of a high diversity of animal species (score 3: different species of different taxonomic groups), whereas 6 proposed pictures of different

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animal species of the same taxonomic group (score 2), 6 proposed pictures of a single animal species (score 1), and only one respondent proposed pictures without any animal.

However, when looking more closely at the number of pictures displaying each taxonomic group (Fig.3), most pictures showed mammal species (N=80 out of 149). A lower extent of pictures showed birds (N=30), reptiles and amphibians (N=17) and arthropods (N=7). However, no fish appeared at all in the pictures. Comparatively, 17 pictures only displayed vegetation, devoid of animal species (Fig. 3). In comparison, the MJP displays 50 species of mammals, 70 of birds, 50 of reptiles and amphibians and 10 of arthropods; the PZP displays 42 species of mammals, 74 species of birds, 38 species of reptiles and amphibians and 15 species of fishes. Results suggest that although the two zoos display more species of birds than mammals and other taxonomic groups, participants took more pictures of mammals.

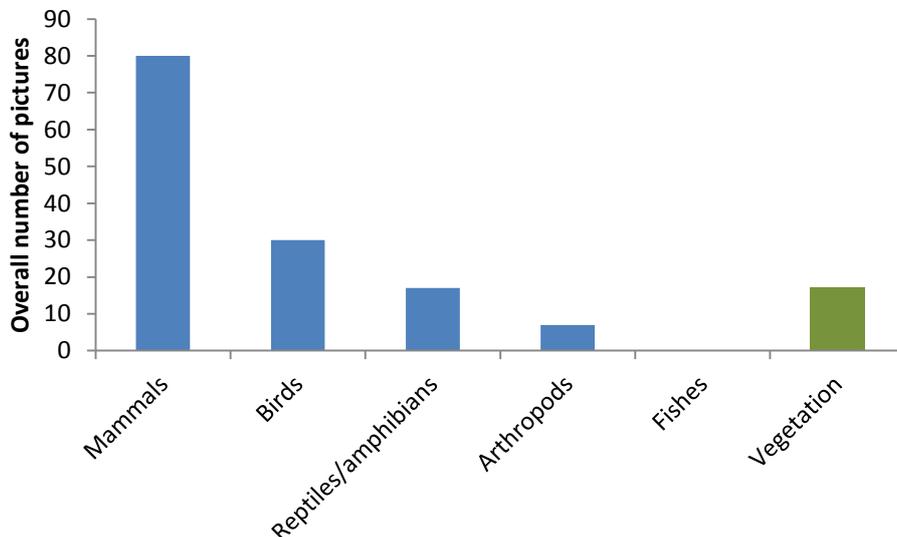


Figure 3: Number of pictures showing each taxonomic group of animals and vegetation devoid of animal species.

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Figure 4: Participant's picture displaying a landscape view of the zoo. Caption was *"the head in the clouds; big rock, the zoological building well imitated from a natural rock"*.



Figure 5: Participant's picture that included a person, in front of the Sea lions basin. Caption was *"Projection in water"*.



Figure 6: Participant's picture displaying a captive species, within its surroundings. No caption was provided.



Figure 7: Participant's picture displaying a close-up view of a caged animal. No caption was provided.

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Comparison with expectations of visitors toward animals at the zoo

Data will be soon included in the manuscript.

Analysis of captions

Different types of captions could be noted: first, there were captions in which participants provided a very brief and objective description of the content of the picture. For instance, such captions could describe a place or an animal (e.g. *"Pond"* or *"Chameleon"*), or a status (e.g. *"Family"* or *"mother"*) or behavioral event (e.g. *"Catch"*, *"group outing"* or *"grooming baboons"*). Other captions provided more content, often subjective. Indeed, some participants seemed to anthropomorphize the animals through their captions (e.g. *"Mrs Giraffe"*), whereas others clearly showed empathy for the animals, speaking in the voice of the animal (e.g. *"Hey it's me!"* or *"I'm handsome"*). Interestingly, we noted that some participants made inferences about the emotional state of the animals: e.g. *"the baby lion is naturally standing on the ground, he seems concentrated on what is happening; he is still young and thus remains very active and playful"*, *"With this heat, like in the wild, he waits for a bit of fresh air"* or *"the impatient otter"*. One participant provided pictures of an Orangutan and clearly emphasized its phylogenetic proximity to humans (*"our cousins!"*). Finally, we noted positive general comments about nature (e.g. *"water for life"*, *"trees are our allies to breathing"*, *"nature invests everywhere she can"* or *"East of Eden, nature is marvelous"*), and more precise comments about the more common biodiversity in the zoo (e.g. *"bird in a bush; wild nature in the menagerie"*, [speaking of the aviary of the MJP] *"free entrance, green green green"*), while another participant clearly distinguished "nature" and "zoo" (*"an Oryx in the woods: impossible in nature but surprising in a zoo"*, *"Savannah animals in the fog: original and unconceivable in nature"*).

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Discussion

The study examined the perceived naturalness of the zoo, and more precisely, what people consider as nature in the zoo. We analyzed the content of photographs taken by zoo visitors, and which supposedly show “nature”. Asking zoo visitors to take photographs of “nature” at the zoo provided us with a picture of their perception of nature at the zoo, and how they consider captivity and human presence in this perception.

First, examination of the perceived naturalness of a list of different places showed that the zoo is rated more natural than urban green spaces, gardens and households, but less natural than Amazonia and forests, which were characterized by high levels of nature. In addition and interestingly, the two places rated with highest perceived naturalness (i.e. Amazonia and forest) were also characterized with relatively high level of agreement between participants, and this level of agreement seemed to decrease with the level of perceived naturalness; in other words, perceived naturalness of gardens, urban green spaces and households largely vary between participants, whereas they almost all agreed that Amazonia and forests are characterized by a great amount of nature. Moreover, in Western countries, people usually perceive Amazonia as a place of pristine nature, with the tropical rain forest that is growingly disappearing due to deforestation. Complementarily, forests, even highly managed by humans, still represent “nature, which is supposed to be largely free from human activities or left in its original state (...) and a region of wilderness which seems to be different from the intensively used urban area” (Schmithüsen & Wild-Eck, 2000, p. 404). At the opposite, urban parks are managed greenspaces that provide structured recreation and contact with nature (Rupprecht et al. 2015). Our results suggested a gradient of management in the perceived naturalness of the listed places: indeed, Amazonia and forests were perceived as the most natural, whereas urban greenspaces, gardens and households were perceived as the less natural. In this gradient, zoos are perceived as less managed than urban green spaces.

In general, content analysis of the participants’ photographs revealed that zoo visitors largely emphasize the captive animals in their assessment of nature at the zoo, with a vast majority of pictures showing caged animals, in comparison to photographs of overall

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landscapes, non-captive species or vegetation solely. In addition, although most participants seemed to show a diversity of animal species in their pictures, when we looked more closely at different taxonomic groups displayed, mammals were largely predominant, followed then by birds, reptiles and amphibians, and arthropods. Thus, some participants, through their pictures, linked “nature” at the zoo with a diversity of animal species (from various taxonomic groups) and vegetation solely; e.g. a picture of a mammal, a picture of a bird, a picture of a reptile, a picture of an arthropod and a picture of vegetation solely. However, many other participants did not dedicate a whole picture to vegetation solely, and very few provided pictures of arthropods. Previous literature showed that attitudes toward animals largely vary from one species or taxonomic group to another, with a large preference for large vertebrates, mammal species (e.g. Frynta et al. 2013; Ward et al. 1998), species that are rare or charismatic (e.g. Angulo et al. 2009) and primates, due to their strong similarities with humans (Plous 1993). Accordingly, zoo visitors generally spend more time watching at exhibits of mammal species (Moss and Esson 2010). At the opposite, invertebrates generally elicit fearful or aversive emotional responses (Kellert 1993). Accordingly, the two zoos display more species of birds than mammals or other taxonomic groups, which reinforce our observation that people emphasize mammals compared to other groups. Nevertheless, most participants considered the animals with their surroundings, to some extent, and only very few pictures were close-up views of the animals. This suggests a consideration for the animal within his environment, even if the vegetation is not directly emphasized. Although previous research on representations of biodiversity highlighted that most people acknowledge the “diversity” component, defining biodiversity as a *variety* of elements (e.g. species, habitats, genes) (Buijs et al. 2008), other research focused on the perception of plant diversity in urban parks revealed that knowledge of plant richness by park users is poor and focused on ornamental plants, and that users were attentive to the surrounding plant richness mostly for aesthetic and restorative reasons (Muratet et al. 2015).

It is however worth noting that at the zoo, people’s perception of “nature” emphasizes animals, mostly captive, rather than a broader view of the landscape in the zoo. Indeed, only very few pictures were landscape views of the zoo. Exploration of representation of the term “biodiversity” reveals that many people with no particular background in natural resource

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management consider biodiversity as all things living, often including diversity of landscape (Buijs et al. 2008). Thus, it is surprising that we did not find more emphasis on landscape, since they seemed to consider the zoo as a place with a relatively high level of perceived naturalness. Accordingly, humans were rarely represented in the pictures: only one photograph clearly showed a person, and four other photographs were landscape views of the zoo where visitors could be sighted. It is therefore surprising to note that although people generally feel part of the natural world (Schultz 2001), they do not include humans within their pictures of “nature”. Previous research (Buijs et al. 2008) however nuanced such assumption, stressing that some people feel part of the natural world, whereas others believe humans are separate or distinct from nature. It thus remains unsure whether the zoo strengthens this dichotomy between humans and nature, instead of helping people feel part of the natural world, especially through physical barriers separating visitors from captive animals. Nevertheless, it is important to note that participants made clear efforts to take pictures devoid of fences.

It is surprising that we did not find any difference on the characteristics of the pictures, between the two zoos, since they are very different, especially in terms of plant coverage and urban biodiversity. This suggests that even in PZP, where vegetation level remains quite low due to recent renovation, participants made efforts to include vegetation in their pictures. However, it remains unsure whether participants intentionally included vegetation in the pictures because they believe vegetation is an important component of what nature is, or simply for aesthetic purposes on the picture (in other words, a background with vegetation would look better than a background with concrete, engines or any other bad-looking element).

Content analysis of the captions provided us additional information for a better understanding of how zoo visitors perceive nature at the zoo. Indeed, although some visitors remained very descriptive and objective, other clearly made assumptions of emotional states of the animals, anthropomorphized them or showed empathy toward them. This is consistent with previous literature, stating that the zoo could allow people bond with the animals (Clayton, Fraser, and Saunders 2009), and that this sense of connection to the animal is positively related to self-reported pro-environmental behaviors (Grajal et al. 2016).

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Accordingly, anthropomorphism and empathy toward the natural world are counterproductive with conservation, but could rather help promote conservation attitudes and behaviors (Schultz 2000; Tam 2013b; Tam, Lee, and Chao 2013).

This study however shows limitations, since respondents were zoo visitors, so they are very likely to have positive beliefs about zoos; this could thus explain why the zoo was considered as more natural than urban green spaces. It would therefore be interesting to conduct a comparative study with zoo non-visitors. As a consequence, our study highlighted the zoo visitors' perception of nature at the zoo, and does not pretend that our results are generalizable to the entire population. Additionally, despite a huge amount of distributed flyers inviting people to participate, our sample size of respondents was relatively low, even if we collected a reasonable amount of pictures.

To conclude, this study exploring the zoo visitors' perception of nature at the zoo showed that there is a large emphasis on the captive animals, compared to non-captive animals and vegetation solely. Obviously, zoo visitors have strong expectations toward caged animals, so they may not perceive the uncaged wildlife, as it is often the case in large cities' streets (Skandrani et al. 2015) and urban parks (Shwartz et al. 2013). Thus, it appears logical that people take pictures of what they actually see, i.e. captive species. However, although respondents emphasized animals rather than landscape views, they seemed to consider the animals within their environment, in comparison to close-up pictures. We further hypothesize here that people do not only show an overall preference for large vertebrates and mammal species, as shown in previous literature, but also consider as "nature" in the zoo almost only captive species, mostly mammals. With the on-going biodiversity crisis and urgent need to raise people's awareness and concern for the local biodiversity, the contribution of zoos remains uncertain, regarding our results.

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An anthropological exploration of soundscape in zoos: exoticism as a mediator of everyday experiences of nature

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Abstract

The increasing levels of stress entailed by today's urban lifestyles can lead to a greater desire to escape from urban environments where there are few opportunities to experience nature. The restorative sense of *being away* produced by natural environments has been substantially explored where green areas are concerned, but little is known about the restorative potential of zoos, which endeavour to immerse visitors in a local or more exotic environment. The sense of immersion relies not only on visual environment, but also on soundscape. In contrast to visual stimuli, sounds are perceived passively and actively, allowing memories to emerge. In this study, we conducted a qualitative exploration of the way soundscapes contribute to sense of immersion and *being away* among zoo visitors. We conducted self-reflective interviews with 20 participants in two urban zoos in Paris (France), which involved recording sounds during their visit to the zoo, and then inviting each participant to an interview based on playbacks of excerpts from the recordings. We characterized three types of perceived sounds, human, mechanistic and natural. The participants seemed to perceive the zoo as a natural or a socially crowded area depending on the auditory context. Interestingly, while many participants distinguished captive animals from uncaged fauna based on sounds, focusing on the captive exotic animals seemed to make them more aware of the more common and uncaged avifauna around them in the zoo. By combining exotic and common fauna, zoos could therefore potentially increase attentiveness and care for urban biodiversity among urban dwellers.

Keywords: soundscape; immersive landscape; natural sounds; urban biodiversity; zoo

Highlights

- Three types of sounds were mentioned: human, natural and mechanistic.
- Human sounds were perceived positively if the experience was shared.
- Zoo visitors distinguished the sounds of captive animals from those of urban avifauna.
- Attentiveness towards zoo animals enhances visitor perceptions of urban fauna.
- Zoos have the potential to increase attentiveness and care for urban biodiversity.

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Introduction

Increasing urbanization has many benefits in terms of access to health care, education and social support (McMichael 2000; Vlahov and Galea 2002; Dahly and Adair 2007). However, urban dwellers experience high levels of stress and mental illness, such as depression (Srivastava 2009), partly due to the few opportunities in cities for being in nature (Ulrich et al. 1991; Howley 2009; Byrne, Wolch, and Zhang 2009). Urban dwellers, wherever they are in the world, seem to express a desire to be in contact with nature (Matsuoka and Kaplan 2008). The restorative potential of immersive nature experiences, compared to built environments, has been repeatedly shown. In particular, according to Attention Restoration Theory (ART), intensive use of directed attention can lead to mental fatigue, and some settings help to recover effective functions more than others (Herzog et al. 2003; Kaplan and Kaplan 1989). Natural environments are particularly likely to be restorative, because they are distinct from daily activities and obligations (*being away*), because they capture people's attention effortlessly (*fascination*), and because they are spread out in time and space, thus providing more than a short-lived experience (*extent*) (Kaplan and Kaplan 1989). Without being geographically distant, natural urban environments can give a sense of escape to city dwellers who spend their real lives surrounded by built urban infrastructure. The restorative aspects of urban parks compared to urban settings have been extensively documented (Hartig et al. 2003; Ulrich et al. 1991). However, natural environments in cities are not restricted to urban parks (Colding 2007). Zoos are another kind of natural setting whose exoticism provides additional opportunities for *being away*.

In addition to the idea of *being away*, recently designed zoos often use Coe's *immersive landscape* concept to increase the visitor's feeling of being immersed in the natural environment of the animals displayed (Coe 1985). The purpose is to increase the sense of proximity with the animal, in order to make the encounter as memorable as possible, as in the wild. To achieve this, the visitor moves around in the same recreated habitat as the animal, and the physical barriers separating animals from visitors are reduced as much as possible. Coe stressed that, in order to make the zoo visit effective in immersing the visitor, the six elements of what makes an encounter in the wild memorable must somehow be present with zoo animals as well: anticipation (i.e. knowing that animals could be nearby and

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that it is possible to encounter them), lack of distraction (i.e. quiet environment), novelty (i.e. having a novel experience so that habituation does not occur), fulfilment of an expectation (e.g. seeing a large animal), emotional involvement (i.e. the multisensory emotional reaction to an animal) and reinforcement (e.g. reliving the experience later with siblings and acquaintances) (Coe 1985). For instance, according to Coe, the necessary lack of distraction would not be present in the case of a noisy crowd in the zoo, which could prevent the experience from being memorable (Coe 1985).

The feeling of immersion, especially the emotional involvement, relies on many different sensory stimuli besides vision. Although vision is mostly considered as the foremost sense through which the surrounding environments and landscapes are perceived (Oldoni et al. 2015), the human anatomy not only allows the surroundings to be visually perceived, but also allows the perception to be controlled by closing one or both eyes. Human ears, on the other hand, can perceive all the surrounding sounds, but we have little control over the auditory stimulations we receive (Blauert 1985). The auditory components of a landscape are therefore worth exploring in terms of the sense of immersion. In 1993, Ogden et al. explored the role of sounds in zoo visitors' sense of immersion by artificially playing natural sounds in zoo displays, and found a positive effect of these artificially played natural sounds on immersion (Ogden, Lindburg, and Maple 1993). However, it remains to be seen whether spontaneous natural sounds could also contribute to the immersion of zoo visitors.

The auditory component of a landscape is also particularly important in the context of psychological restoration: noise levels have been found to be important determinants of restorativeness, notably in urban parks (Jabben, Weber, and Verheijen 2015). The soundscape has been defined by R.M. Schafer as "*[a]n environment of sound (or sonic environment) with emphasis on the way it is perceived and understood by the individual, or by a society*" (Truax 1978). An increasing amount of research has been exploring the soundscape of natural and urban environments. Among others, several studies aimed to define a perceptual-based typology of urban soundscapes, and the main sources that can be encountered in each of the categories (Maffiolo 1999; Guastavino 2006; Raimbault and Dubois 2005). In most of these studies, the first level of association concerning the nature of sources is related to human-made vs. natural sounds. More recent studies on soundscapes

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have further demonstrated that human-made sounds play an important role in soundscape perception in urban parks or recreational areas (Jeon and Hong 2015; Hong and Jeon 2015).

Zoos have a distinctive soundscape, one that differs from urban parks in both volume and sources of sound. Zoos are found in most large cities around the world and millions of people from different backgrounds visit them every year (Gusset and Dick 2011; Lafon and Bazin 2013). Zoos are therefore important institutions in urban contexts, probably because for many people, they are a cheap and easy way of encountering exotic animals, if not the only way for those who cannot afford to travel abroad. An important motivation for visiting a zoo appears to be recreational (Reade and Waran 1996; Carr and Cohen 2011). The social component of a zoo visit has indeed been widely acknowledged: many zoo visitors are groups of people who wish to share the experience of encountering zoo animals (Clayton, Fraser, and Saunders 2009; Fraser et al. 2009). As zoos attract large numbers of visitors, many human voices and noises can be heard in a zoo, and thus contribute to the perceived soundscape of such recreational areas. Moreover, because zoos display caged animals that people cannot observe in urban parks, the natural sounds people hear in a zoo can differ from those in urban parks, including the sounds made by caged animals. The soundscape in zoos is therefore likely to differ from the soundscape in urban parks, with more human sounds to be expected, and different natural sounds in zoos than in parks. . Finally, a zoo visit is a multi-sensory experience, since it allows people to observe the animals for real, but also to hear, smell and sometimes even touch them, whereas this is not possible through mass media such as television or websites (Rabb 2004).

In addition, even though the natural environment of the animals on display is mostly suggested by growing exotic plants there, zoos also host local urban plants, which grow there spontaneously, and urban animals that come into zoos to use their food and nesting resources. It has been shown that urban species are rarely noticed by city dwellers, either in public spaces (Skandrani et al. 2015) or in urban parks (Shwartz et al. 2014). One reason for this low level of perception of surrounding urban nature could be habituation. Because they explicitly promise exotic experiences, zoos could provide opportunities for people to perceive surrounding urban biodiversity in a different way, even if they mostly come to see caged, and often exotic, animals. Birds appear to be the most readily perceived urban

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wildlife, and birdsong has been found to contribute to perceived attention restoration (Ratcliffe, Gatersleben, and Sowden 2013). It thus remains to be seen whether sounds from urban biodiversity –especially birds - could contribute to the restorative component of a zoo visit, as well as to visitor immersion, in a context where visitors are not expected to pay attention to these species.

In the study presented here, we explored the conditions in which specific zoo soundscapes contribute to immersion and restoration among visitors. More specifically, we first conducted a qualitative exploration of zoo soundscapes. We then focused on the perception of human sounds, because of their importance in perceptions of soundscapes in urban parks and recreational areas, and because the social and emotional component of a zoo visit has been widely acknowledged. Finally, we explored how natural sounds, both from caged and uncaged wildlife, can contribute to the sense of immersion and of *being away*, in such urban settings. We proceeded by conducting qualitative anthropological surveys in the two urban zoos in Paris (France), one of which is designed to be immersive, with 10 volunteers in each zoo. The idea was not to compare the two zoos, but to sample two different zoos to collect a broader range of perceptions depending on the type of zoo experience.

Methods

Study places: zoos

The study was conducted at two Parisian zoos: the Menagerie of the Jardin des Plantes, and the Paris Zoological Park (Fig.1). The Menagerie (MJP) is one of the oldest zoos in the world, and is located in the middle of Paris. It is a relatively small zoo (5.5 ha), characterized by relatively small cages that are housed in listed historical buildings. Enclosures currently display about 1200 animals of 180 different species. A great amount of large trees and bushes are currently growing in the Menagerie, which is surrounded by a botanical garden (Jardin des Plantes) and has a busy street running along one side. The Menagerie had 643 000 visitors in 2014 and 515 000 in 2015.

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The Paris Zoological Park (PZP) is larger, at 14 hectares, and also has a history in Paris, since it opened in 1934, but in 2008 it was closed for rebuilding for several years. It reopened to the public in April 2014, as an immersive zoo: efforts were made to evoke the natural habitats of the animals, with five different biozones (Patagonia, Sudan-Sahel, Europe, Guyana and Madagascar). This comprises a tropical greenhouse that immerses the visitors. The new version of the zoo displays a small number of animals in large enclosures (altogether about 2000 animals of 180 different species), where the physical barriers have been removed or made as unobtrusive as possible. Because the zoo was entirely rebuilt, the vegetation was very sparse when it reopened; it is gradually growing and spreading, but compared to the Menagerie, the site still seems quite bare of trees and shrubs. The PZP has roads on all three sides, and a public park with a lake and woodland is located nearby. It had 1 239 000 visitors in 2014, the year when it reopened, and 910 000 in 2015.

Because the two zoos are outdoor spaces that are not hermetic to the outside environment, urban species colonize both zoos, even the tropical greenhouse in the PZP. Birds make up the great majority of these colonizing species, and enter the zoo mainly for foraging purposes. For instance, the blackbird (*Turdus merula*), the feral pigeon (*Columba livia*), the common wood pigeon (*Columba palumbus*), the blue tit (*Cyanistes caeruleus*), the great tit (*Parus major*), the Eurasian wren (*Troglodytes troglodytes*), the Eurasian coot (*Fulica atra*), the common moorhen (*Gallinula chloropus*) and the carrion crow (*Corvus corone*) are common bird species that can be observed in both zoos.

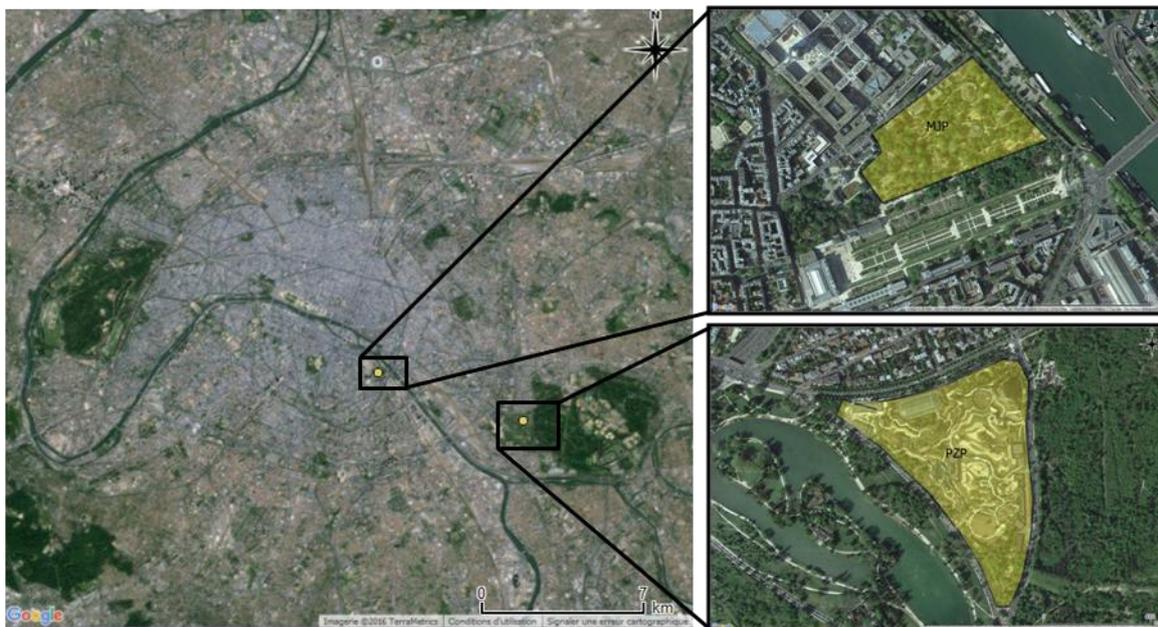


Figure 1: Aerial photographs of the study sites. The large photograph on the left is an aerial view of Paris; the Menagerie of the Jardin des Plantes is shown in the top-right photograph, while the bottom-right photograph shows Zoological Park of Paris.

Experimental protocol

For the study, conducted from April to June 2015, we used a 4-step procedure based on an adaptation of existing methodologies (Thibaud 2001; Battesti 2015): (1) a call for volunteers, (2) an adapted soundwalk method (Semidor 2006; Jeon, Hong, and Lee 2013), (3) the audio recording process, and (4) self-reflective interviews (Theureau 2010) with volunteer participants.

Participants

First of all, we called for volunteers on the Menagerie's Facebook page, a recruitment protocol that was likely to target people familiar with zoos and with positive beliefs about them. People were asked to fill in a short online questionnaire that allowed us to select a sample of participants of different ages and genders. We selected ten participants in each zoo. The participants (12 women and 8 men, average age 34) had normal hearing and were neither ornithologists nor professionals in the sound industry (Table 1). They were contacted by the experimenter (LM), who explained the study process to them and scheduled two dates for each participant: they would visit the zoo on one day, and participate in an

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interview on the day after the visit. Ten of them visited the zoo on their own (6 in the Menagerie and 4 in the PZP), and ten others were accompanied (4 in the Menagerie and 6 in the PZP); there was no set length to the visits, which lasted from 1 to 5 hours (average 2:20 hours). The participants were compensated for their time with a free zoo entrance ticket to use for a future visit. They were informed that all the data collected (questionnaire data, recordings of the visit and recordings of the interviews) would only be used for research purposes, and that these data could be deleted on demand. An informed consent form was signed by each participant before beginning the visit.

Table 1: Description of the participants' characteristics. MJP stands for Menagerie of Jardin des Plantes, and PZP stands for Paris Zoological Park.

ID	Day of visit	Visited Zoo	Type of visit	Frequency of visits to the zoo visited before participating in the survey	Professional occupation	Gender	Age	Overall duration of visits (h:min)
29	05/04/15	MJP	On own	Once a year	Artist	man	27	1:44
47	04/24/15	MJP	On own	More than once a year	<i>Unknown</i>	woman	43	2:05
77	04/22/15	MJP	In group	Only once	Chemist	man	48	2:45
90	04/25/15	MJP	On own	More than once a year	Environmental student	woman	24	1:20
114	05/09/15	MJP	In group	Only once	Journalist	woman	40	2:43
117	05/15/15	MJP	In group	Less than once a year	Informatic technician	man	41	2:11
139	04/08/15	MJP	On own	More than once a year	Restaurant owner	woman	26	1:20
166	06/14/15	MJP	On own	More than once a year	Biologist	woman	39	1:16
12	04/11/15	MJP	In group	More than once a year	History student	man	25	3:03
146	04/15/15	MJP	On own	More than once a year	Life sciences teacher	man	38	1:43
2	05/20/15	PZP	In group	Only once	Illustrator	woman	37	2:33
17	05/17/15	PZP	In group	Less than once a year	Editor	man	31	2:40
25	04/13/15	PZP	On own	Only once	Unemployed	woman	29	3:17
48	04/19/15	PZP	In group	Never	Graphist Volunteer in organic farms	woman	40	5:11
49	05/23/15	PZP	On own	Never		man	23	1:01
59	04/16/15	PZP	On own	More than once a year	Commercial/Marketing	woman	29	2:26
75	05/07/15	PZP	In group	More than once a year	Photographer Student in communication	man	29	2:40
88	04/21/15	PZP	On own	Never		woman	30	1:30
111	05/20/15	PZP	In group	More than once a year	<i>Unknown</i>	woman	46	1:54
158	05/18/15	PZP	In group	Only once	<i>Unknown</i>	woman	50	3:43

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Soundwalk

The soundwalk method was originally implemented by Schafer (Schafer 1991), but has been adapted and used several times since (Battesti 2015; Davies et al. 2013; Semidor 2006; Jeon, Hong, and Lee 2013). This method aims to identify and characterize a particular soundscape (Adams et al. 2008) by asking participants to walk along a predefined route, with stops to verbalize about what they have heard. However, for the purpose of our study, it was important that the paths taken during the zoo visit should be entirely chosen by the participant in order to represent a typical zoo visit as much as possible: they were free to visit some animals and avoid others, or to remain longer in one part of the zoo or another. We therefore adapted the soundwalk method to these constraints: participants freely visited one of the two zoos, either alone or accompanied. They were equipped with binaural microphones (ZOOM H4N recording device coupled with DPA–SMK-SC4060 microphones; see Fig. 2a) that recorded all the sounds occurring during their visit as accurately as the participants heard them. As supported in the literature (Semidor 2006), the use of a binaural recording system was essential in this study because it encodes the soundscape as the human binaural auditory system does. They therefore record what is actually perceived by the participant as similarly as possible. When the participants listened to the binaural recordings, they had better recall and could more readily reimmerge themselves in the experience of the zoo visit during the self-reflective interview. In addition to the microphones, the participants received a GPS tracking system (GPS data logger Cattrack®) that allowed us to match the audio recording to the location in the zoo during the recording process. The participants were informed about the devices they would be carrying in a light backpack, and were free to remove the equipment whenever they wanted (e.g. when using the bathroom or during a private conversation); they were asked to contact the experimenter if they had any difficulty putting the devices back in the right position. The experimenter met the participants at the zoo entrance, set up their equipment, systematically asked them about any discomfort or decrease in hearing abilities, and made sure the participant was free to move without any discomfort. No participant complained about any discomfort. The experimenter remained in the zoo during the visit (but apart from the participants). The participants called the experimenter to return the equipment when they were ready to leave the zoo at the end of the visit. Most participants in our study told

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the experimenter, when handing back the equipment, that they quickly forgot the presence of the equipment they were carrying. The weather conditions during the visits were stable, with no rain.

Selection of excerpts for the interview

After the visits, the experimenter processed the audio recordings by selecting five 2 minute-long excerpts from the total recording of a single zoo visit, based on the content and the location of the recording. The selection of excerpts could not be standardized, as participants were not required to follow a specific path. Moreover, some parts of the recordings were more private conversations between visitors and could not be used for the interviews. Because our purpose was not to make a quantitative comparison of participants' perceptions of the soundscape in similar places in the zoo, but rather to explore their perceptions according to the characteristics of different places (e.g. numbers of visitors, presence of traffic noise, presence of animal sounds), the excerpts were selected according to the following criteria: first of all, the excerpts had to be ethically usable (i.e. no private conversation, no over-familiar language that participants might be uncomfortable listening to), and of sufficient auditory quality (audible, and not unpleasant to listen to). Regarding the content of the excerpts, we selected a variety in order to represent the following types: scenes with a large amount of human sounds (including human-human interactions), scenes with the presence of non-human sounds from the zoo, scenes with natural sounds not from the zoo (e.g. urban species, mostly birds), scenes with mechanical sounds (e.g. engines, proximity to road), scenes with water sounds (e.g. waterfall), scenes with a transition between two environments (e.g. from outdoors to indoors), and scenes with human-animal interaction (Appendix 1). Efforts were made to select excerpts in diverse sectors in each zoo (Appendices 2 and 3).

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Self-reflective interview

The day after the visit, the experimenter met the people who had carried the binaural microphones for self-reflective interviews. This is a method used to obtain information on basic listening or acoustic experiences (Augoyard 2001). During the interviews, the participants were asked to listen to the excerpts of the recording of their zoo visit, to improve their recall of their experience within the zoo. Although most previous research on soundscapes using soundwalk methodology have relied on questionnaires (Jeon and Hong 2015; Hong and Jeon 2015; Liu et al. 2014), we chose in this case to adopt a more anthropological approach, with long interviews of the participants to get a deeper insight into their auditory experience in the zoo. Even if participants were accompanied during their zoo visit, only the person carrying the binaural microphones was interviewed. The participants were equipped with open headphones allowing them to hear both the experimenter and the audio recording (AKG K1000) (Fig. 2b); the interview was recorded, and lasted from 40 to 90 minutes. All participants were interviewed by the same experimenter (LM), in a quiet room in the research lab. The participant was asked several questions: two questions were asked before listening, inspired from Davies and colleagues' previous work (Davies et al. 2013): (1) "Could you please tell me what you heard during your visit?" (2) "Would you say that you experienced only one or several different auditory atmospheres?". These first two questions allowed us to explore the nature and frequency of sounds the participants had remembered, as well as the way they discriminated between them.

The participants were then asked three questions after they had listened to each of the excerpts to (in random order), also inspired from previous work (Augoyard 2001): (3) "What do you hear?" (description of surrounding sounds) (4) "Do you personally think that there was any remarkable auditory element?" ("remarkable" here means something which appears in the foreground) (5) "What did this excerpt evoke during your visit?"

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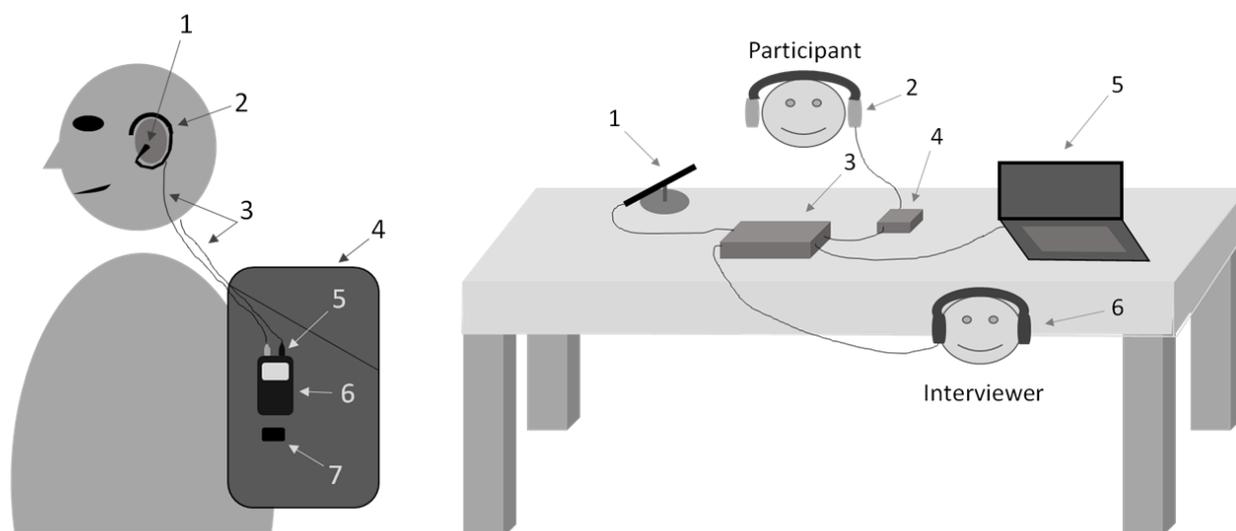


Figure 2: (a) Experimental design for recordings during zoo visits; 1-microphone (DPA-SMK-SC4060); 2: copper rod coated with black adhesive tape to hold the microphone, and flexible enough to be adaptable to each participant's ears; 3: wires; 4: backpack (5 litres) containing 5, 6 and 7); 5: spatialized plugs (left and right); 6: recording device (ZOOM H4N); 7: GPS data logger (Cattrack®);

(b) Experimental design for the self-reflective interview; 1: microphone (ref); 2: open headset allowing the participant to hear surrounding sounds while talking (AKG K1000); 3: external sound card (Focusrite Scarlett 2i2); 4: headset volume control (Dayton Audio – DTA 1); 5: laptop for use of Reaper software (Reaper 4.78; free trial version); 6: headset (Sony MDR-7506).

Analysis

Altogether, the experimenter explored 44 hours of zoo visit recordings, to select 100 excerpts for the self-reflective interviews (i.e. 5 excerpts per person).

The 20 interviews were entirely transcribed and then analyzed for answers to our research questions, using Sonal software (Alber 2009). Each element the participant described in response to an excerpt was analyzed against the selection criteria for the content of the excerpt (e.g. whether natural sounds could be heard or not, see Appendix). We first characterized the overall soundscape of the zoo by classifying the sounds mentioned by the participants in response to questions (1) and (2) (based only on what participants recalled

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from their visit) into three categories, depending on their source: natural sounds (water, birdsong, animal vocalizations, wind), human sounds (talking and footsteps) or mechanistic (traffic noise, construction noise, mechanical noise). These categories have already been used in the literature (Jeon and Hong 2015; Payne, Davies, and Adams 2009). Because participants mentioned between 3 and 16 different elements, we selected only the first three elements mentioned by each participant, and calculated their frequency (i.e. number of participants mentioning it) and the average rank (i.e., mentioned by the participant firstly, secondly or thirdly) of each category of sound, in the two zoos (Table 1), using Anthropac software (Borgatti 1996). We then made a closer analysis of the qualitative content of the participants' discourse, to gain a deeper insight into the way people perceived the three different types of sounds in the zoo. All the responses were grouped by question type, but are presented together below due to the overlap between themes. We then made a semantic analysis to identify common topics. Once the quotes with common themes were grouped together, each situation was analyzed for the context of sound production (i.e. location in the zoo, time, number of visitors in the zoo, social interaction, zoo animal sounds, urban wildlife, echo and sound level). This analysis allowed us to consider each situation in its context.

Results

Overall characterization of the zoo soundscapes

Through this quantitative analysis, we characterized the soundscapes of the two studied zoos. The respective importance of perceived natural and human sounds differs between the two zoos: natural sounds were mentioned more often than human sounds in the MJP, and vice-versa in the PZP (Table 2). The relatively higher proportion of human sounds in the PZP could be explained by the context of the zoo visit: the PZP has many more visitors each day than the MJP, and more participants in the PZP visited the zoo during a busy period, compared to those in the MJP. In both zoos, human and natural sounds were mentioned more often than mechanistic sounds. However, the few participants who mentioned

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mechanistic sounds gave them priority, as they were among the first sounds they remembered.

Table 2: Frequency (out of 20 people) and order (from 1 to 3) in which participants mentioned the three categories of sounds (i.e. natural, human and mechanistic) in both zoos.

Category	Menagerie		Paris Zoological Park	
	Frequency (%)	Average rank	Frequency (%)	Average rank
Natural sounds	100	2.20	70	2.43
Human sounds	70	2.57	90	2.11
Mechanistic sounds	20	1.50	60	1.83

More qualitatively, the content of the participants' memories consistently included natural sounds, but these tended to be mentioned after human and mechanistic sounds, which is surprising for a zoo. For instance, one person mentioned the presence of children and their parents, then the mechanistic and technical sounds due to the process of feeding of the animals, and only mentioned animal sounds at the end.

"Yesterday, there were many children, so I heard many comments and sounds from children. Sounds from parents, too; I mean adults who make a lot of comments. Yesterday was quite an active day in the zoo so we also heard the sounds in the zoo, announcements on the PA system, they were quite frequent. And because it was in the morning, I think they were making preparations to feed the animals so it was quite noisy ... with mechanical sounds actually, technical ... I mean like equipment noises... and then animal noises". (Woman, 27 years old, PZP)

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More generally, the human sounds mentioned mostly referred to children's voices (e.g. laughing, crying or shouting). Concerning the mechanistic sounds, participants tended to refer to “city” or “behind the scenes” sounds. One participant highlighted the traffic noise in one part of the zoo, which is located near a road.

[Speaking about the Patagonia area] *“There, we can also still hear a great deal of noise from the city around”.* (Man, 27 years old, PZP)

Another participant referred to “behind the scenes” sounds, which suggests that she was aware of being in an artificially made and controlled setting.

“From 5 p.m. they apparently feed the animals, so we heard wheelbarrows, doors opening or closing. It is pretty funny. It feels like being behind the scenes”. (Woman, 50 years old, PZP)

Finally, regarding natural sounds, participants frequently mentioned bird vocalizations and, to a lesser extent, primates:

“Bird songs, yes, but the free ones, and then the animals... like the cacophony of flamingos in the aviary, and, I know, uh, I think, the parrots in the greenhouse (...)”.(Woman, 28 years old, PZP)

“Birds, I mean those we usually hear in Paris”. (Woman, 23 years old, PZP)

Interestingly, the participants apparently distinguished vocalizations that were produced by exotic caged birds from those that were produced by urban avifauna. The urban bird sounds were more often mentioned in the MJP than in the PZP. However, this could be explained by the recent renovation of the PZP, where the plant cover is less extensive than in the MJP, suggesting that fewer urban birds are present than in the MJP.

The acoustic properties of the buildings had a strong impact on the auditory experience of the visitors. In particular, the indoor ambience can be very different to that outdoors, partly because of the change in the perceived auditory level at the entrance or exit of a building: acoustic cut effects for sudden decreases of intensity, and acoustic irruption effects when the auditory level suddenly increases (Augoyard and Torgue 1995). Therefore, the acoustic

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properties of a given building can produce specific noises, which are positively perceived by some participants as reminding them of the history behind the building. Buildings are therefore also components of the zoo's ambience:

"It feels like going 150 years back in time; also, the building has not changed, I think it was built in 1926 (...) but anyway, it's part of something bigger, it's an atmosphere".
(Man, 25 years old, MJP)

Perception of human sounds: both positive and negative

Among the 20 participants to whom we played an excerpt in which a large number of visitors could be heard, 14 remembered the discomfort they felt during the visit because of the noise made by the public.

This strong perception of human voices gave many participants the impression of the zoo being a public place. Some participants compared it to a funfair, to a department store during a sale, or even to a busy metro, in terms of human presence and voices:

"It feels like being at the Foire du Trône [a famous funfair in Paris]"! (Woman, 42 years old, MJP)

"Actually, it felt like peak hours in big stores, which are enclosed spaces where people don't pay any attention to each other; they talk loudly, they gather in front of things, all that... and I don't like it, I find this kind of atmosphere oppressive". (Woman, 28 years old, PZP)

"Going into the vivarium was like, I was going to say, the metro, but it is exactly like that... A crowded, unpleasant place where you resent people, so, the metro, that's not a bad comparison... because it feels like we are on top of each other, so, yes, the metro is what it feels like...". (Woman, 38 years old, MJP)

The acoustic properties of the buildings were liable to strengthen the impressions and feelings of visitors. For instance, one woman participant mentioned a pressing need to

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“quickly get out of” the MJP ape house, because the “building in itself” had a “strong echo”; this echo was also noticed by another participant, who therefore avoided the building:

“From the sound point of view I sometimes avoid rooms, those rooms, because it tires me out and... because there we really hear that the noise is, how can I put it ... reverberated? Because of the echo, it creates a confusion of noises”. (Man, 38 years old, MJP)

However, although human sounds can be disturbing when perceived as simply noise, they can be positively perceived as soon as one pays attention to what others are saying. In this case, human sounds provide the opportunity to share the zoo experience. Such is the case, for instance, of exclamations about a previously hidden animal that someone has finally spotted: these exclamations can be positively perceived, since they allow visitors to participate in a positive encounter with the animal they can now see. The shared sense of wonder towards an animal is another commonly mentioned experience:

“During the visit it was nicer to hear the amazed comments made by people around than idle chatter, because we felt like we were sharing an emotion, whereas before that we didn't care about people's personal lives, we don't go to zoos to hear about other people's lives (laughter) (silence)... that's it: infectious wonderment, you know? Sharing the experience”. (Woman, 49 years old, PZP)

Perception of natural sounds: exotic caged animals highlight the presence of common biodiversity

Although natural sounds did not emerge first in the free recall exercise at the beginning of the interviews (see above), we noted interesting patterns in participants' mentions of natural sounds during the self-reflective part of the interviews.

First, participants clearly noticed the vocalizations of captive birds, compared to what they are used to hearing in the city:

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“Songs from more tropical birds, we really hear that these songs are different from those outside”. (Woman, 45 years old, PZP)

“It’s funny but we actually feel like they come from somewhere else. This is not what are used to hearing in Paris, so it’s true that it’s nice.”(Woman, 27 years old, PZP)

However, even when clearly distinguished from the captive animals, the urban biodiversity seemed to be somehow perceived as part of the zoo. Even if they were not originally part of the animal collection of the zoo, urban birds still belong to the zoo because of their permanent presence:

[Speaking about carrion crows (*Corvus corone*)] *“They probably belong to the zoo anyway, since the food of the other animals attracts them, anyway they’re here every time we go”. (Man, 25 years old, MJP)*

These vocalizations of urban birds were able to elicit memories, and contributed to the well-being of the visitor at that moment:

“... a feeling of well-being..., memories too because with my father we liked to walk, settle down and listen to the birds... more like countryside birds, forest birds, all that. Of course, not at all in the same category, but it made a link”. (Woman, 28 years old, PZP)

Some participants were able to name some species of urban birds, e.g. carrion crows (*Corvus corone*), but being able to identify them was not the key to distinguishing them from the exotic fauna: even if they were not able to name a species, they were able to note whether the bird song came from an urban or caged bird.

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Whether made by exotic or urban fauna, these natural sounds were able to capture the participants' attention, allowing them to ignore other types of sounds, such as mechanistic ones. They were therefore more prone to feel as immersed as in a natural environment. For instance, one participant remembered being attracted with his son by the song of the wintering snowy owl (*Bubo scandiacus*), which he compared to the song of a local owl species, the Tawny owl (*Strix aluco*), and a truck passing by at this moment (audible in the recording) did not attract their attention at all. This example concerns an exotic species, but another example could be mentioned, this time concerning a non-captive species, the Eurasian coot (*Fulica atra*): the participant mentioned concentrating hard to locate the bird she had heard.

“This is a noticeable sound, because we don’t often hear a owl song like that, these animals are not usually seen, we’re more used to hearing owls hooting, the Tawny owl, the “HOU HOU” rather than shrill songs like that. So this was a pleasant evocation of this episode”. (Man, 47 years old, MJP)

[Speaking about the Eurasian coot (*Fulica atra*)] *“But we were really focused! (...) On the one hand we were looking for frogs, which we didn't find, and on the other hand we were so focused on finding the nest in the vegetation and we were confused because (...) depending on where we were, we could hear the bird singing in the sky, or then to the left or right in the vegetation. We couldn’t locate it at all, it was quite amazing. And I forgot to look for the bird’s name...”(Woman, 50 years old, PZP)*

Apart from focusing their attention, natural sounds coming both from captive and uncaged animals contributed to the sense of immersion of the participants, especially in closed display areas such as the aviary or the tropical greenhouse:

“We were really surrounded by bird songs”. (Woman, 39 years old, MJP)

It therefore helped participants to feel a sense of *being away*, as far away as in the jungle (or a sense of what a jungle is), or simply away from the surrounding urban area:

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“The sense of a jungle”. (Woman, 50 years old, PZP)

“I mean the representation we have of it”. (Woman, 50 years old, PZP)

“We enter the greenhouse and Wow! We're not in Vincennes anymore [the neighbourhood near the zoo]”! (Man, 30 years old, PZP)

Therefore, as one participant pointed out, common natural sounds (e.g. urban birds) helped to put visitors in a “bubble”, isolating them from the nearby urban environment; the sight and/or sound of more exotic animals carried them away:

“I think that the first sound of chirruping birds (sparrows) already put us in a bubble and then the macaws carried us far away”. (Man, 38 years old, MJP)

The zoo visit still allowed participants to perceive an “elsewhere”, as some of them noted, although they remained well aware that they were still in an urban setting.

“It breaks the spell”. (Woman, 38 years old, MJP)

“But in other places, we could imagine being somewhere else”. (Woman, 38 years old, MJP)

“We are well aware that we're still in the middle of Paris”. (Woman, 38 years old, MJP)

Discussion

Our results showed that an ambience was perceived in the zoo, and that both visual and auditory aspects contributed to this ambience. Soundscapes are closely related to perceptions of the visual environment in urban spaces (Southworth 1969). The sight of the natural environment and animals on display, as well as the zoo architecture more generally (e.g. buildings) create an ambience, but are not the only components of it: for instance, the acoustic properties of the buildings contributes to the ambience created, as well as other sounds in the zoo. We noted that human voices could be both negatively perceived because they evoked crowded public places, and positively perceived as long as the shared

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experience contributed to the sense of wonder. This result is supported by previous research showing that human sounds were positively perceived if they were elements of communication or social interaction, but negatively perceived in cases where they clashed with the aspirations attached to specific sites (Carles, Barrio, and de Lucio 1999). Accordingly, previous research have shown that the sharing of emotions towards animals, both positive and negative, promotes social interactions (Clayton, Fraser, and Saunders 2009; Fraser et al. 2009). The shared emotional experience thus contributes to a positive perception of human sounds. Research on soundscapes in urban parks has also highlighted the importance of human-made sounds in soundscape perception (Jeon and Hong 2015).

Even if human voices and mechanistic sounds were negatively perceived, because they prevented visitors from feeling immersed in a natural environment, our results showed that natural sounds allowed participants to ignore these unpleasant sounds to some extent, and to feel immersed despite them. Previous research has highlighted people's preference for natural sounds over mechanistic ones (Guastavino 2006), and the potential of natural sounds (i.e. water) to mask road-traffic sounds (Axelsson et al. 2014). Furthermore, a recent study has shown that the sight of outdoor vegetation is a strong and statistically significant factor in reducing the level of noise nuisance for urban dwellers near busy roads (Van Renterghem and Botteldooren 2016). Immersion does not have to be in an exotic environment; rather, participants should simply be able to feel they are away from their daily urban routine. Some participants highlighted the difference between caged animals and more common ones, saying that some bird songs were produced by exotic birds because they were not commonly heard in Paris. This suggests that the sounds produced by the more exotic animals helped to evoke a sense of being elsewhere, as participants were able to recognize that the sound they heard was not part of their daily lives. Also, surprisingly, we noted that a large proportion of the natural sounds mentioned by the participants referred to urban biodiversity, notably urban birds. These sounds were mentioned in both parts of the interviews (free recall and self-elicitation), suggesting that the urban avifauna was not only perceived but also remembered. Common natural sounds seem thus to be an important component of the zoo visit experience. Previous research has shown that birdsong plays an important role in people's daily lives by marking moments in time (Whitehouse 2015), or for

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their restorative effect (Ratcliffe, Gatersleben and Sowden 2013). Natural sounds produced by uncaged wildlife in a zoo, like urban birds, could therefore be an important factor of attention restoration in zoos: birds sounds are perceived as easy to be attentive to, without making much demand on one's attention or affect; they are also associated with relative novelty, which contributes to their perceived ability to distract (Ratcliffe, Gatersleben, and Sowden 2013). Moreover, birdsong, as well as water sounds, has been found to be more capable than human sounds of inducing states of relaxation (Bjork 1995, in Carles, Barrio, and de Lucio 1999). As one participant put it, hearing these common natural sounds put him into a nature “bubble”, and the sight of exotic animals (i.e. macaws, in the quote) then carried him away. What this suggests is that the expectations visitors have towards the more exotic animals do not necessarily prevent them from perceiving urban wildlife.

The important and positive role of birdsong has already been recognized in the perception of urban soundscapes (Liu, Kang, and Behm 2014). Some participants even stressed their high level of concentration when trying to spot the urban bird they were mainly hearing. This suggests that the attention and concentration visitors show towards caged animals actually put participants in a better position to perceive the more common wildlife. Habituation sometimes overshadows what is “common”: for instance, recent research has shown that there are many more people in cities who show no interest at all in very common birds such as the feral pigeon (*Columba livia*) than people who interact with them, either positively (e.g. observing, feeding) or negatively (e.g. launching projectiles at them) (Skandrani et al. 2015). We therefore hypothesize here that exotic zoo animals allow visitors to feel a sense of escape, and that this sense of escape gives visitors a new perspective on the sounds of common urban wildlife. In other words, exoticism could act as a mediator for everyday experiences of nature, an assumption that concurs with previous research suggesting that sounds may be perceived differently depending on the function of a place (Liu et al. 2014; Hong and Jeon 2015) or on the context (Ballas and Mullins 1991; Carles, Bernáldez, and Lucio 1992).

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Conclusion

This survey confirms the results of previous research with artificially induced natural sounds (Ogden, Lindburg, and Maple 1993), by showing that natural sounds are an important contributor to the feeling of immersion in zoos, and that exotic displays help visitors to perceive more common wildlife. Our results suggest that while zoos can bring a sense of *being away* and thus aid restoration through effortless attention, they can at the same time focus the visitor's attention and concentration on spotting the animals, which causes them to better perceive the more common avifauna. A zoo could thus be considered as an oasis of nature in an urban environment, helping people to disconnect from their daily urban routines.

These results have important implications in terms of urban landscape planning and management, since they highlight the importance of zoos in visitors' perceptions of common biodiversity. We could also hypothesize that since what is exotic in a zoo reveals what is more common, zoo visits could have implications for reconnecting people with the everyday experience of nature.

Further research would be necessary on the richness and abundance of common biodiversity in zoos, and to assess their potential as reservoirs of biodiversity in the urban matrix. It would also be relevant to make quantitative assessments of soundscapes in zoos with acoustic measurements, as in recent research on urban parks. Based on our results, we would advise zoos to focus more strongly on developing their educational strategies on urban biodiversity and, depending on their potential as biodiversity reservoirs, to increase the richness and abundance of their urban biodiversity by adapting their management practices. Changing gardening practices, for example, has been found to have a positive impact on urban biodiversity (Shwartz et al. 2013). We would also advise zoo designers to pay more attention to soundscape and not only landscape, as the soundscape plays an important role in the visitors' sense of immersion, and because natural sounds can improve the quality of built-up environments to a certain extent (Carles, Barrio, and de Lucio 1999; Axelsson et al. 2014). Finally, we advise landscape and urban planning managers to reconsider zoos as biodiversity reservoirs, both to increase urban biodiversity and to enhance people's perception of urban wildlife.

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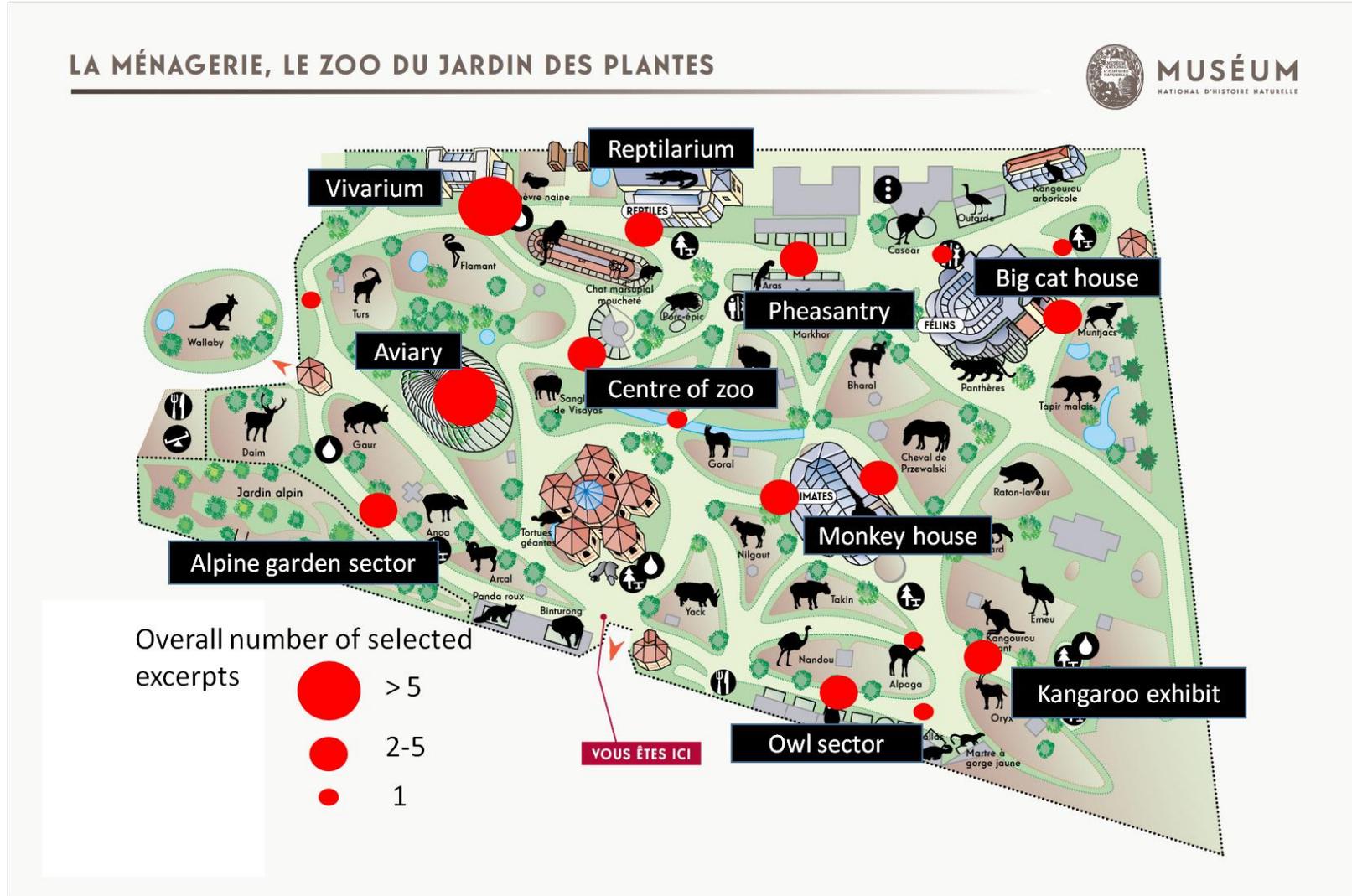
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Appendix 1: List of locations of selected excerpts against selection criteria, per participant (ID). MJP: Menagerie of Jardin des Plantes; PZP: Paris Zoological Park.

ID	Zoo	Human sounds	Non-human natural sounds from the zoo	Urban species, mostly birds	Mechanical sounds	Water sounds	From outdoor to indoor or vice-versa
29	MJP	Owl sector, Monkey house, Alpine garden sector, Vivarium	Owl sector, Monkey house, Vivarium	Owl sector, Monkey house, Big cat house, Alpine garden sector	Owl sector, Monkey house, Big cat house	-	Monkey house, Big cat house, Vivarium
47	MJP	Aviary, Vivarium, Monkey house, Oryx exhibit, Big cat house sector	Vivarium, Monkey house, Oryx exhibit	Aviary, Vivarium, Monkey house, Oryx exhibit, Big cat house sector	Aviary, Monkey house, Oryx exhibit, Big cat house sector	-	Vivarium, Monkey house
77	MJP	Aviary, Reptilium, Owl sector, Caracal exhibit, Kookaburra exhibit	Owl sector, Caracal exhibit	Aviary, Reptilium, Owl sector, Caracal exhibit, Kookaburra exhibit	Aviary, Reptilium, Owl sector, Caracal exhibit, Kookaburra exhibit	Aviary	Reptilium
90	MJP	Monkey house, Vivarium, Aviary, Ostrich exhibit	Monkey house, Vivarium, Owl sector	Monkey house, Vivarium, Aviary, Ostrich exhibit, Owl sector	Aviary, Ostrich exhibit	-	Monkey house, Vivarium, Aviary
114	MJP	Aviary, Ostrich exhibit, Macaw sector, Monkey house, Center of zoo	Aviary, Macaw sector, Center of zoo	Aviary, Ostrich exhibit, Macaw sector, Monkey house, Center of zoo	Aviary, Ostrich exhibit, Macaw sector	-	Monkey house
117	MJP	Macaw sector, Oryx exhibit, Monkey house, Aviary, Vivarium	Macaw sector, Monkey house, Vivarium	Macaw sector, Oryx exhibit, Monkey house, Aviary	Macaw sector, Oryx exhibit, Monkey house, Aviary	-	Vivarium
139	MJP	Monkey house, Owl sector, Reptilium	Owl sector, Reptilium, Pheasantry, Vivarium	Monkey house, Owl sector, Reptilium, Pheasantry, Vivarium	Monkey house, Owl sector, Vivarium	Reptilium	Monkey house, Reptilium, Vivarium
166	MJP	Macaw sector, Kangaroo exhibit, Vivarium, West Caucasian tur exhibit, Monkey house	Macaw sector, Vivarium	Macaw sector, Kangaroo exhibit, Vivarium, West Caucasian tur exhibit, Monkey house	Kangaroo exhibit, Monkey house	-	Vivarium, Monkey house
12	MJP	Aviary, Oryx exhibit, Vivarium, Big cat house, Pheasantry	Oryx exhibit, Vivarium, Big cat house, Pheasantry	Aviary, Oryx exhibit, Big cat house, Pheasantry	Aviary, Oryx exhibit, Big cat house	Aviary	Vivarium, Big cat house, Pheasantry
146	MJP	Vivarium, Alpine garden sector, Big cat house sector, Aviary	Vivarium, Aviary	Vivarium, Alpine garden sector, Big cat house sector, Aviary, Owl sector	Big cat house sector, Aviary, Owl sector	Alpine garden sector, Aviary	Vivarium
2	PZP	Aviary, Sea lions bassin, Tropical greenhouse, Addax exhibit, Information house in Patagonia	Aviary, Sea lions bassin, Tropical greenhouse	Addax exhibit	Aviary, Tropical greenhouse, Addax exhibit, Information house in Patagonia	Sea lions bassin, Tropical greenhouse	Tropical greenhouse
17	PZP	Lion exhibit, Aviary, Sea lion bassin, Bridge above pond, Tropical greenhouse	Aviary, Sea lion bassin, Tropical greenhouse	Bridge above pond	Sea lion bassin, Tropical greenhouse	Aviary, Bridge above pond, Tropical greenhouse	Tropical greenhouse
25	PZP	Bridge above pond, Aviary, Ostrich exhibit, Penguins bassin, Tropical greenhouse	Aviary, Penguins bassin, Tropical greenhouse	Ostrich exhibit, Penguins bassin	Bridge above pond, Ostrich exhibit, Penguins bassin, Tropical greenhouse	Bridge above pond, Tropical greenhouse	Tropical greenhouse
48	PZP	Aviary, Sea lion bassin, Wolf exhibit, Rhinoceros exhibit, Tropical greenhouse	Aviary, Tropical greenhouse	Wolf exhibit	Aviary, Sea lion bassin, Wolf exhibit, Rhinoceros exhibit, Tropical greenhouse	Tropical greenhouse	-
49	PZP	Oryx exhibit, Tropical greenhouse, Pudu exhibit, Vultures sector, Aviary	Oryx exhibit, Tropical greenhouse, Aviary	Oryx exhibit, Vultures sector	Oryx exhibit, Tropical greenhouse, Pudu exhibit, Vultures sector	Tropical greenhouse, Vultures sector	Tropical greenhouse, Vultures sector
59	PZP	Giraffe exhibit, Otter bassin, Rhinoceros exhibit, Tropical greenhouse	Rhinoceros exhibit, Tropical greenhouse	Giraffe exhibit, Otter bassin, Bats exhibit	Giraffe exhibit, Otter bassin, Rhinoceros exhibit, Bats exhibit, Tropical greenhouse	Otter bassin, Tropical greenhouse	Tropical greenhouse
75	PZP	Lemurs exhibit, Sea lion bassin, Zebra exhibit, Tropical greenhouse, Vultures exhibit	Lemurs exhibit, Sea lion bassin, Tropical greenhouse	Lemurs exhibit, Zebra exhibit, Tropical greenhouse, Vultures exhibit	Lemurs exhibit, Zebra exhibit, Tropical greenhouse, Vultures exhibit	Lemurs exhibit, Sea lion bassin, Tropical greenhouse, Vultures exhibit	Tropical greenhouse
88	PZP	Pudu exhibit, Aviary, Zebra exhibit, Sifaka exhibit, Sea lion bassin	Aviary	Pudu exhibit, Zebra exhibit, Sifaka exhibit	Pudu exhibit, Aviary, Sea lion bassin	Aviary, Sifaka exhibit	-
111	PZP	Wolf exhibit, Rhinoceros exhibit, Giraffe exhibit, Tropical greenhouse, Bush dog exhibit	Tropical greenhouse	Wolf exhibit, Rhinoceros exhibit, Bush dog exhibit	Wolf exhibit, Rhinoceros exhibit, Tropical greenhouse, Bush dog exhibit	Tropical greenhouse	Tropical greenhouse
158	PZP	Aviary, Pudu exhibit, Bridge above pond, Giraffe house, Tropical greenhouse	Aviary, Tropical greenhouse	Pudu exhibit, Bridge above pond, Tropical greenhouse	Aviary, Pudu exhibit, Bridge above pond, Giraffe house, Tropical greenhouse	Bridge above pond, Tropical greenhouse	Giraffe house, Tropical greenhouse

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Appendix 2: Location and number of selected excerpts on the map given to visitors of the Menagerie of the Jardin des Plantes.



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Appendix 3: Location and number of selected excerpts on the map given to visitors of the Paris Zoological Park.



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Chapter 3:

Does a zoo visit help reconnecting people with nature?

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Introduction

Increasing both the opportunities and the orientations, i.e. the willingness to engage with the natural world is essential to reconnect people with nature. Providing green spaces close to where people live and work (J. R. Miller and Hobbs 2002; Soga et al. 2015) is one strategy to enhance opportunities for nature experiences. As described in the introduction, the strong effects of childhood experience of nature on connectedness to nature (Chawla 1988), frequency of visits and type of natural places visited (manuscript 1 – in introduction) suggest that it may be particularly important to provide children more opportunities to experience nature. As suggested by the first study on natural places (manuscript 1) and by the preliminary study on the experience of zoo visit (chapter 1), zoos are considered by some people as being a “natural place”. And a large proportion of zoos visitors are families, with adults bringing their children to the zoo, either on an educational, recreational, or both purposes. The zoo visit therefore seemed to provide an experience of nature, allowing people to encounter both captive, often exotic, animals, and uncaged wildlife, as suggested in chapter 2. It however remains to be seen whether a zoo visit can affect people’s orientations toward the natural world.

In manuscript 4, we thus explored the potential of zoos in increasing adults’ orientations toward the natural world and its conservation, by looking at whether visitors felt more connected to nature and more concerned for biodiversity at the exit of the zoo, compared to visitors who were entering the zoo. Indeed, it remains unclear whether a single zoo visit could affect connectedness to nature: previous literature showed that explicit measures of connectedness to nature remained unchanged after a zoo visit, but an increase in implicit measures of connectedness to nature was observed (i.e. connectedness to nature was assessed through an implicit association test), suggesting that visitors might not be aware of this increase (Bruni, Fraser, and Schultz 2008). Similarly, we know that positive emotional experiences toward zoo animals are associated with higher support for conservation (Kals, Schumacher, and Montada 1999; Allen 2002; Hayward and Rothenberg 2004; Myers, Saunders, and Birjulin 2004), but the real impact of the zoo visit on concern for biodiversity has not been explored so far, to our knowledge. Innovatively, we also tested whether sense of connection to nature and attitudes toward conservation were differently affected for zoo

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visitors and zoo non-visitors (i.e. urban park visitors), to investigate the potential of zoos, compared to another natural public place.

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Can zoo visit link nature connectedness to biodiversity concern? Comparative analysis between zoos and parks in Paris, France

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Abstract

Given the growing need to restore an intimate relationship between humans and nature, in order to better achieve conservation goals, zoos have been considered as places for experiencing nature in urban settings, and for educating people about conservation. However, the effect of a zoo visit on a relationship with nature and on conservation attitudes remains subject to debate. Importantly, much research assessing the impact of the zoo visit has focused solely on zoo visitors, though a comparison with a sample of zoo non visitors would be necessary to truly explore the effect of the zoo on such variables. This study therefore aimed to explore the effect of a single zoo visit on connectedness to nature and conservation attitudes, and to investigate whether predictors of connectedness to nature and conservation attitudes were similar in zoo visitors and in a comparison group of park visitors. We addressed questionnaires to 435 zoo visitors, and to 121 urban park users in France, mostly in Paris. We found that visitors exiting the zoos did not feel more connected to nature and concerned for biodiversity than entering visitors, suggesting that a single zoo visit did not have a significant impact. However, the extent of experience of zoo visits was positively related to concern for biodiversity, which also differed depending on the motives for the visit. Our comparison between zoo visitors and urban park users revealed that connectedness to nature was related to age of respondents, and to their frequency of visits to natural places, for both samples. However, we found that connectedness to nature was positively related to concern for biodiversity among zoo visitors, but not among urban park users. Zoos may therefore serve not to affect connectedness to nature, but to prime conservation attitudes among those who already feel connected.

Key words: connectedness to nature, conservation attitudes, zoo visit, urban park

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1. Introduction

The current biodiversity loss and increasing urban lifestyle in Western countries have progressively reduced people's opportunities and willingness to go to nature, which led to what Pyle called the "extinction of experience": a growing habituation to lower levels of biodiversity (Pyle 2003). Soga and Gaston (2016) recently highlighted that the extinction of experience has various consequences for individual well-being, attitudes, emotions and behaviors, and that those consequences can reduce in turn the opportunities and orientations to go to nature. Indeed, nature experience provides numerous benefits, on individual well-being (Howell et al. 2011), health (Mitchell and Popham 2008), and attention restoration (Kaplan and Kaplan 1989), but also for environmental issues, because it can help foster conservation attitudes, through environmental knowledge (Bögeholz 2006) and sense of connection to nature (Schultz 2001). It is therefore crucial for conservation issues to reduce this extinction of experience, and thus to look at how people can experience nature in urban settings.

Experiencing nature is a way to increase individual connectedness to nature and/or individual concern for biodiversity (Chawla 1988; Schultz 2001). The connectedness to nature can be considered as belonging to individual identity, and includes multiple components, which can be broadly grouped in cognitive, emotional (affective) and social components (Clayton and Meyers 2009). Indeed, experience of nature is not limited to direct contacts with nature, as largely highlighted in previous literature (e.g. Soga and Gaston 2016). Indeed, it refers to the "process of getting knowledge or skills from doing, seeing or feeling things" or to "something that happens to you that affects how you feel" (dictionary.cambridge.org), and therefore implies deeper changes in the way individual feels, as well as their identity. Nature experiences can lead to various forms of attachment, which can lead to a sense of belonging to a place or a community, which in turn can be a source of commitment for preserving the landscape (Lokocz, Ryan, and Sadler 2011). Individual concern for biodiversity refers more to attitudes (Stern and Dietz 1994).

In environmental psychology, much research effort has explored the extent to which people feel connected to nature, leading to various models and measures, which have been

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repeatedly shown to correlate with each other (Schultz 2001; Restall and Conrad 2015; Prévot, Servais, and Piron 2016). One of them in the Environmental Identity scale proposed by S. Clayton (2003), which covers multiple dimensions such as the interactions with the natural world, the importance of nature and the positive emotional reactions toward nature. Another one is the Inclusion of Nature in Self (INS) proposed by P.W. Schultz (2001) as a measure of the extent to which people cognitively feel interconnected to nature. Though the different measures represent slightly different ways of conceptualizing the construct, they concur in assessing the extent to which an individual represents his/her own connection to nature. People who appear more connected to nature, according to these scales, tend to demonstrate a greater tendency to attend to and care about the natural world. Indeed, inclusion of nature in the self (e.g. Davis, Green, and Reed 2009), connectedness to nature (e.g. Gosling and Williams 2010) and environmental identity (e.g. Clayton, Fraser, and Burgess 2011) have all been found to relate to environmental concern (see Restall and Conrad 2015 for a review of potential of connectedness to nature for environmental management). Additionally, a social context that supports concern for biodiversity may lead to a “conservation social identity”, or a willingness to socially represent oneself as someone concerned about conservation.

Experiencing nature seems hardly feasible in cities and large metropolis (Miller 2005). Yet, cities design diverse urban green infrastructures besides public urban parks (Colding, Lundberg, and Folke 2006). Some improbable places to encounter and experience nature in the cities include zoos. Indeed, in addition to giving the opportunity to observe animals, zoos place visitors both in the recreated natural habitat of the displayed animals and in an overall green area relatively similar as what could be found in urban parks. Moreover, zoos are visited by millions of people every year and worldwide (Gusset and Dick 2011), from a very diverse population (e.g. in the Menagerie of Jardin des Plantes, in Paris: Lafon and Bazin 2013). More particularly, urban and periurban zoos are visited largely by people living in the zoo vicinity, i.e. city inhabitants: for instance, Karanikola et al. (2014) showed that 62.4% of the zoo visitors they surveyed had travelled less than 20km to access the zoo. Zoos, and particularly urban zoos, represent therefore particular places to provide opportunities and orientations (*sensus* Soga and Gaston 2016) to experience nature for a wide range of people

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living in the cities. Compared to other urban green infrastructures, zoos include conservation education in their official aims and objectives (WAZA 2015); they provide therefore opportunities for cognitive connectedness. And indeed, a recent large survey acknowledged the positive effect of a zoo visit on biodiversity literacy (Moss, Jensen, and Gusset 2015). However, besides conservation education, zoos offer also a wide potential in increasing people's connectedness to nature. Fraser et al. (2009) proposed for instance that zoo visitors may use the animal encounters to "explore their own environmental identities", and "to contemplate human responsibility to the biological world". More precisely, zoos offer experiences of close animal encounters that elicit various emotional responses, mainly positive (Myers, Saunders, and Birjulin 2004), and such positive emotional responses have been found to be related to higher environmental concern and support for conservation (Kals, Schumacher, and Montada 1999; Myers, Saunders, and Birjulin 2004; Allen 2002; Hayward and Rothenberg 2004). In addition, zoo visit is often a social experience. For many visitors, the zoo represents an opportunity for family- or friend-based trips (Reade and Waran 1996; Turley 2001; Ryan and Saward 2004). Clayton et al. (2009) showed that zoo animals are used to facilitate social interaction, especially among family groups. Additionally, the sharing of emotional experiences toward zoo animals have been found to contribute to social cohesion in groups of teenagers (Fraser et al. 2009). In a more recent study, Colleony et al. (manuscript 3) showed that zoo visitors may even be willing to share experiences with strangers at the zoo, not only members of their own group.

Previous studies suggest that zoo visitors have higher levels of environmental identity than zoo non-visitors (Clayton, Fraser, and Burgess 2011). The effect of a particular visit on connectedness to nature remains unclear: Bruni et al. (2008) showed that visitors did not explicitly feel more connected to nature after the zoo visit, but using an implicit association test, they found a significant increase of the implicit connectedness to nature after the visit (Bruni, Fraser, and Schultz 2008). Nevertheless, repeated visits could have an effect on the connectedness to nature. For instance, Clayton et al. (2014) found that not only were zoo members higher in a feeling of connectedness with nature or animals than non-members, the frequency of visiting the zoo was positively correlated with a feeling of connectedness.

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Zoo visitors have different expectations toward their visit: Falk et al. (2007) highlighted that motivations including curiosity, provision of an experience to accompanying social group, or close tie between the institution's content and people's passions. They further found that the expectations people have toward their visit influence the way they conduct their visit, and what meaning they make from the experience (Falk et al. 2007), by exploring the relationship between different categories of motivations and conservation knowledge of 1862 adult zoo visitors using pre- and post-visit instruments. Their results showed that visitors with a certain motivation showed significant changes in knowledge on conservation after the visit (Falk et al. 2007). These results suggest that depending on their motives for the visit, visitors learn differently about conservation of biodiversity, and that in turn, their level of concern for biodiversity is likely to differ. In addition to being possibly affected by motivations for the visit, level of concern for biodiversity could also differ depending on the extent to which people feel interconnected to nature. Thus, connectedness to nature, as well as motives for the visit, could both affect the aspects of the zoo visit that people attend to.

Our study aimed to explore the impact of a zoo visit on both connectedness to nature and concern for biodiversity, together with the combined effect of the zoo visit and connectedness to nature, on concern for biodiversity. To do so, we originally conducted two comparative surveys, one on zoo visitors and one on non-zoo visitors. Our main focus was on the urban context, given the importance of providing city dwellers more opportunities to experience nature. We thus sampled people visiting urban zoos and people visiting other urban greenspaces, i.e. urban parks. Based on a quantitative survey of 556 people in two urban zoos and three urban parks, we were able to assess the impact of a zoo visit on connectedness to nature and biodiversity concern in two different ways: first we compared these indicators for people asked in the way in and in the way out of the two zoos, as previously done in several studies (e.g. Moss, Jensen, and Gusset 2015); secondly, and more originally, we compared the effects of visiting a zoo compared to an urban park, and thus the potential of zoos for increasing people's orientations toward the natural world, and attitudes toward conservation.

2. Methods

2.1 Study sites

We first collected data within two zoos owned by the French National Museum of Natural History (MNHN): (1) the Menagerie (MJP) is a small zoo (5.5 ha) established in 1794, located in the center of Paris, and which hosts approximately 1200 animals of 180 different species; (2) the Zoological Park of Paris (PZP) is a larger zoo (14.5 ha) built in 1934, located in the suburb of Paris, which was closed for several years (2008-2014) for renovation and opened recently as an immersive zoo; it now displays around 2000 animals of 180 different species in five distinguished biozones (Patagonia, Sahel-Sudan, Europe, Guyana and Madagascar). These two zoos were selected in order to survey a large sample of diverse people visiting different types of zoos, since the two zoos differ in size and type of exhibits.

We then surveyed urban park users, as a control group. We collected data in three urban parks in Paris: (3) the Jardin des Plantes (JDP) is a botanical garden (approx. 23 ha) belonging to the MNHN, located in the center of Paris; the Menagerie is established within this park; (4) Monceau park (MCE) is an urban park (8.25 ha) located in the North West part of Paris; and (5) Montsouris park (MSO) is an urban park (15 ha) situated in the South part of Paris. Both (4) and (5) are owned and managed by the city of Paris.

Our focus was on the urban context, with respondents from two urban zoos and three urban parks. However, to explore whether our findings for the urban context also applied to a more rural context, we collected data in the third zoo owned by the MNHN: (6) the Reserve de la Haute-Touche (RHT) is a recent rural zoo of 500 ha (opened to the public in 1980), located in the center part of France, and where more than 1000 animals of 114 different species are presented mostly within a forest landscape.

2.2 Sample and procedures

2.2.1 Zoo samples

Groups of visitors were randomly selected at the entrance or the exit of each zoo, and were approached by a single experimenter who kindly asked them whether they were willing to

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participate in the survey, at various days and times in July and August 2014. Since the entrances of the MJP and the RHT were also their exits, the experimenter mostly targeted entering participants during the first part of the morning and exiting participants at the end of the day, and randomly selected both entering and exiting participants during the middle day hours. In the PZP, the experimenter stood at different locations depending on targeted participants, either entering or exiting visitors, and mostly surveyed entering visitors during the morning and early afternoon and exiting visitors during the rest of the afternoon. The experimenter asked for a volunteer in each group to participate in the survey. A total of 435 adult visitors were surveyed in the three zoos (i.e. 145 in the MJP, 146 in the PZP and 144 in the RHT). The questionnaire took on average 10 minutes to be completed. Participants remained anonymous, no personal information allowing identification (e.g. name or email address) was recorded. Participants were informed that the data were collected only for research purposes. The process was evaluated by the ethical committee of CNRS, and respects all ethical standards required by the National Commission of Computing and Liberties (CNIL).

2.2.2 Park samples

Park users sitting on benches were randomly approached in each park by six different experimenters (3 men and 3 women of similar ages including the experimenter who surveyed zoo visitors, and trained other experimenters). Data were collected during sunny afternoons, at different days in April and May 2016. The questionnaire took on average 5 minutes to be completed. A total of 121 adult park users were surveyed in the three parks (i.e. 44 in JDP, 50 in MCE and 27 in MSO).

2.3 Measures

Park visitors received an abbreviated version of the questionnaire for zoo visitors. In both zoos and parks, we asked three types of questions:

- 1) Two questions regarding their connectedness to nature and their attitude toward biodiversity conservation:

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- An adapted version of the Inclusion of Nature in Self (INS, adapted from (Aron, Aron, and Smollan 1992), see (Schultz 2001)), i.e. a mostly nonverbal measure of 5 sets of overlapping circles, varying in the degree of overlap, representing our relation to nature. This question was presented as following: “please quote which figure is the best representation of your relationship with natural environment”. The INS has been extensively used in research (Liefländer et al. 2013).

- The extent to which they worry about threat on biodiversity using a 5-point scale (1 for “Not at all” to 5 for “Very much”). This question was presented as following: “To what extent do you worry about threat on biodiversity?”

2) Questions that helped us characterize respondents’ opportunities to experience nature currently or in the past, as well as social identity regarding conservation:

- The frequency of visits to natural places, in a 5-point scale (0-“never”, 1-“Few times a year”, 2-“Once a month”, 3-“Once a week” and 4-“Every day”),

- The score of the rurality level of their current habitat, using a 5-point scale (1-“Large city”, 2-“Medium-size city”, 3-“Small city”, 4-“Village” and 5-“Hamlet”)

- The score of the rurality level of their childhood habitat, using the same 5-point scale

- The proportion of friends and relatives that are concerned by biodiversity loss (0-“None”, 1-“1-25%”, 2-“26-50%”, 3-“51-75%” and 4-“76-100 %”). This indicated the level of conservation social identity (CSI) of the respondent.

- Age (year of birth), gender, and whether they currently own a private garden.

3) One question about the role of the zoos: respondents were free to mention several roles, in an open question.

Additionally, we asked zoo (but not park) visitors the reason for visiting the zoo, as an open-ended question, and the number of other zoos they have previously visited (0-“none”, 1-“one”, 2-“from 2 to 5” and 3-“More than 5”). We used this later information as a proxy of their overall zoo experiences. Finally, we recorded whether they were entering or exiting visitors.

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2.4 Statistical analyses

2.4.1 Content analysis of motives for zoo visit and perception of the role(s) of the zoo

We first analyzed the content of the responses to the question regarding the motives for the zoo visit, to categorize those responses, in order to include the motive for the visit in the further analysis.

The content analysis conducted revealed five themes that were: (1) “self” (SEL) comprises all responses focused on self (e.g. “for pleasure”, “to take a breath” or “for a walk”), (2) “social” (SOC) comprises all responses focused on social experiences (e.g. “for my daughter” or “to spend time in family”), (3) “animal” (ANI) comprises all responses where the animal was the motivation for the visit (e.g. “to see the animals” or “to see Nnette⁷”) and (4) “place” (PLA) comprises all the responses where the respondents mentioned a motive to visit the place, for its architecture or atmosphere for example (e.g. “to see the new zoo since the reopening” or “for the atmosphere”). All other responses which did not match with these categories were classified as (5) “others” and were not included in the analyses. We thus added these 4 variables in the data set, and coded as 1 if the respondent has mentioned this type of motive, or 0 if not.

Similarly, we analyzed the content of the responses to the question regarding the perception of the role of the zoo, and built a binary categorization whether the respondent mentioned the conservation role of the zoo (1) or not (0).

2.4.2 Descriptive analysis

We compared the age, gender, frequency of visits to natural places, rurality of their current residence, rural setting during childhood, connectedness to nature and concern for biodiversity for the two sets of respondents (i.e. park users and zoo visitors) using Kruskal-Wallis tests of comparisons of means.

2.4.3 Impact of zoo visits on connectedness to nature and concern for biodiversity

We used linear mixed-effect model (Pineiro and Bates 2016) to explore whether the zoo visit could impact connectedness to nature. We entered connectedness to nature (INS) as the response variable, and whether they were entering or exiting the zoo (EXI), the motive

⁷ Nnette is a famous Orangutan in the MJP in Paris.

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“place” (PLA), the motive “animal” (ANI), the motive “self” (SEL), the motive “social” (SOC), and their experience of zoo visits (NZO) as independent variables. We added a random effect on the zoo variable, because we considered the overall data set and were not interested in differences between zoos, although results are not independent in a single zoo.

Similarly, we used linear mixed-effect model to explore whether the zoo visit could impact concern for biodiversity. We entered concern for biodiversity (BIO) as the response variable, and, similarly, EXI, PLA, ANI, SEL, SOC and NZO as independent variables. We also added a random effect on the zoo variable.

For both analyses, we conducted stepwise model selections based on Akaike Information Criterion (AIC) scores to select the best model for each analysis. Finally, we conducted ANOVAs type III on the best models we selected (package 'car', Fox and Weisberg 2016). ANOVA type III calculates the statistical importance of each variable as it was entered last, i.e. by taking into account the effects of the other variables implemented in the model.

2.4.4 More general determinants of connectedness to nature and concern for biodiversity

We assessed more generally the potential effect of zoo visits on both connectedness to nature and biodiversity concern by comparing these measures for people asked in the zoos and people asked in the parks, and by taking into account personal determinants as well. We used linear mixed-effect models (Pinheiro and Bates 2016).

First, we entered the connectedness to nature (INS) as the response variable, and surveyed group (TYP – i.e. park users and zoo visitors), extent to which they live in a rural place (HAB), rural setting during childhood (RUR), whether they own a garden or not (GAR), their frequency of visits to natural places (VIS), age (AGE) and gender (SEX) as independent variables. We added random effects on the place variable (i.e. the two urban zoos and the three parks), and on the experimenter variable, to control for differences between experimenters. We also considered interactions between independent variables in the model. We then conducted a stepwise model selection based on Akaike Information Criterion (AIC) scores to select the best model. Finally, we conducted ANOVAs type III on the best models we selected (package 'car', Fox and Weisberg 2016).

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Similarly, we used linear mixed-effect model to explore the impact of a list of variables on concern for biodiversity. We entered concern for biodiversity (BIO) as the response variables, and surveyed group (TYP – i.e. park users and zoo visitors), extent to which they live in a rural place (HAB), rural setting during childhood (RUR), frequency of visits to natural places (VIS), age (AGE), gender (SEX), whether they believe the role of the zoo is conservation or not (CON) and the proportion of friends and relatives that are concerned for biodiversity (CSI) as independent variables. We also added random effects on the place and the experimenter variables and considered interactions between independent variables in the model. We then conducted a stepwise model selection based on Akaike Information Criterion (AIC) scores to select the best model, and ANOVAs (Type II Wald chisquare tests) on the best models we selected (package 'car', Fox and Weisberg 2016).

Those two analyses were then conducted on the data from rural zoo visitors, to compare with the findings from urban context.

3. Results

3.1 Descriptive analysis

Respondents' average age were similar in zoos and urban parks (mean_{zoo}=44.21 ± 20.26 years old, mean_{park}=46.88 ± 15.28 years old; Kruskal-Wallis test: $\chi=0.21$, $df=1$, $p=0.65$), and the proportion of men and women did not differ between the two groups, with slightly more women in both samples (Kruskal-Wallis test: $\chi=0.04$, $df=1$, $p=0.84$). However, although the two groups did not differ in the extent to which they spent their childhood in a rural setting (Fig. 1a; Kruskal-Wallis test: $\chi=0.001$, $df=1$, $p=0.93$), surveyed park users currently live on average in more urbanized areas (Fig. 1b; Kruskal-Wallis test: $\chi=27.98$, $df=1$, $p<0.001$) and appeared to visit natural places more often on average than zoo visitors (Fig. 1c; Kruskal-Wallis test: $\chi=10.06$, $df=1$, $p=0.002$).

We did not find any significant difference in the average level of connectedness to nature between park users and zoo visitors (Fig. 1d; Kruskal-Wallis test: $\chi=0.977$, $df=1$, $p=0.549$).

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Nevertheless, zoo visitors expressed a higher level of concern for biodiversity than park users (Fig. 1e; Kruskal-Wallis test: $\chi=6.869$, $df=1$, $p=0.009$).

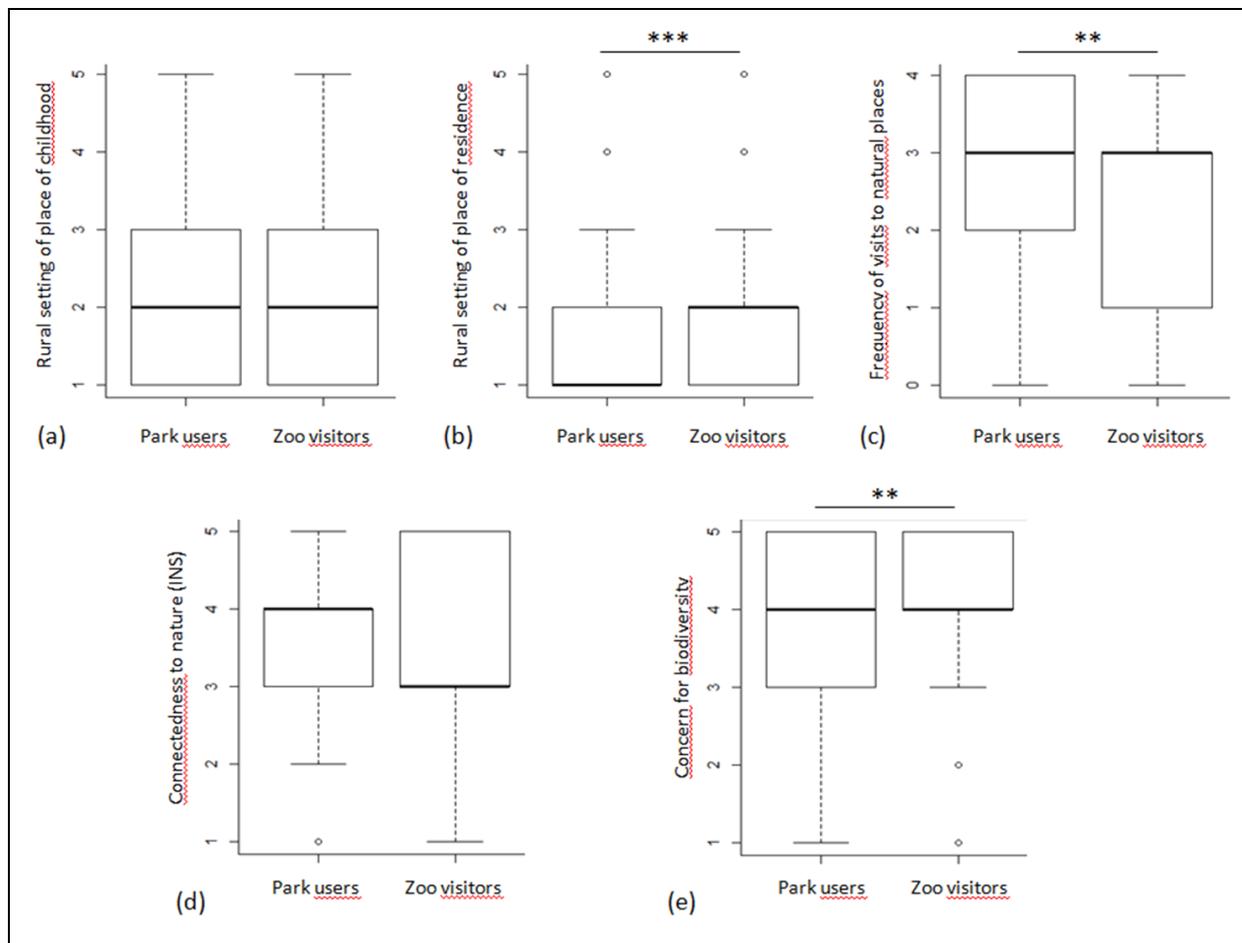


Figure 1 : Mean levels of (a) Rural setting of place of childhood, (b) Rural setting during childhood, (c) Frequency of visits to natural places, (d) Connectedness to nature and (e) Concern for biodiversity between the two surveyed groups (i.e. park users and zoo visitors).

3.2 Impact of zoo visits on connectedness to nature and concern for biodiversity

Connectedness to nature was not affected by any of the independent variables we entered in the model (i.e. whether the visitor was entering or exiting the zoo, motives for the visit, experience of zoo visits) (Table 1; ANOVA: $\chi_{(EXI)}=0.005$, $df=1$ (*ns*), $\chi_{(PLA)}=0.198$, $df=1$ (*ns*), $\chi_{(ANI)}=0.394$, $df=1$ (*ns*), $\chi_{(SEL)}=0.111$, $df=1$ (*ns*), $\chi_{(SOC)}=0.101$, $df=1$ (*ns*), $\chi_{(NZO)}=0.003$, $df=1$ (*ns*)).

However, the different motives for the zoo visit were significantly related to concern for biodiversity (Table 1; ANOVA: $\chi_{(PLA)}=4.051$, $df=1$ ($p<0.05$), $\chi_{(ANI)}=6.386$, $df=1$, ($p<0.05$),

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$\chi_{(SEL)}=0.014$, $df=1$ (*ns*), $\chi_{(SOC)}=6.181$, $df=1$ ($p<0.05$)). In addition, although we did not observe any difference between entering visitors and those exiting zoos (Table 1; ANOVA: $\chi_{(EXI)}=0.104$, $df=1$ (*ns*)), the more respondents already experienced zoos, the more they appeared to be concerned for biodiversity (Table 1; ANOVA: $\chi_{(NZO)}=7.631$, $df=1$ ($p<0.01$)).

Table 1: Summary of the effects of independent variables on connectedness to nature and concern for biodiversity. Levels of significance of ANOVAs are given (* $p<0.05$, ** $p<0.01$, *** $p<0.001$).

Independent variables	<i>Connectedness to nature</i>			<i>Concern for biodiversity</i>		
	Estimates	Standard Errors	t values	Estimates	Standard Errors	t values
Entering/Exiting the zoo	0.009	0.128	0.069	0.039	0.120	0.322
Motive "Place"	0.030	0.066	0.445	0.127	0.063	2.013*
Motive "Animal"	0.039	0.063	0.628	0.148	0.058	2.527*
Motive "Self"	-0.021	0.064	-0.333	0.007	0.060	0.117
Motive "Social"	0.021	0.065	0.318	0.152	0.061	2.486*
Experience of zoos	-0.003	0.062	-0.054	0.161	0.058	2.762**

3.3 Determinants of connectedness to nature and concern for biodiversity

We found positive correlation between connectedness to nature and respectively age (Table 2; ANOVA: $\chi_{(AGE)}=16.093$, $df=1$, $p<0.001$) and frequency of visits to natural places (Table 2; ANOVA: $\chi_{(VIS)}=20.828$, $df=1$, $p<0.001$). The relationship between the extent to which respondents spent their childhood in a rural setting and their connectedness to nature was not significant (Table 2; ANOVA: $\chi_{(RUR)}=3.249$, $df=1$, $p=0.071$), but the effect of other related variables may have decreased the effect of rural setting during childhood. Indeed, separately analyzed, the effect of rural setting during childhood on connectedness to nature was significant (ANOVA: $\chi_{(RUR)}=3.738$, $df=1$, $p=0.05$). Living in a more rural setting at the present time, and owning a garden, did not appear to relate to connectedness to nature. Additionally, as mentioned in the first part of the results, we did not observe any difference between park users and zoo visitors in the connectedness to nature.

According to the biodiversity concern, we did not found any significant effect of the rurality of the childhood residence, of age and of frequency of visits to natural places (Table 2; ANOVA: $\chi_{(HAB)}=0.279$, $df=1$, $p=0.597$; $\chi_{(RUR)}=0.023$, $df=1$, $p=0.879$; $\chi_{(AGE)}=1.103$, $df=1$, $p=0.294$;

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$\chi_{(VIS)}=0.111$, $df=1$, $p=0.739$). However, people more connected to nature showed a significantly higher concern for biodiversity (Table 2; ANOVA: $\chi_{(INS)}=19.76$, $df=1$, $p<0.001$), as well as people with higher proportion of friends and relatives concerned for biodiversity (Table 2; ANOVA: $\chi_{(CSI)}=31.41$, $df=1$, $p<0.001$). In addition, several interactive effects appeared to be significant, as following: first, we found a negative significant interactive effect of age and frequency of visits to natural places (Table 2; ANOVA: $\chi_{(AGE:VIS)}=7.728$, $df=1$, $p=0.005$), suggesting that older respondents who visit natural places more often were less likely than younger ones to say that they are concerned for biodiversity. We found also a significant negative interactive effect of proportion of friends and relatives concerned and connectedness to nature (Table 2; ANOVA: $\chi_{(CSI:INS)}=15.44$, $df=1$, $p<0.001$), suggesting that the effect of proportion of concerned friends and relatives on concern was lower for respondents with a higher connectedness to nature.

Most importantly, we found a significant interactive effect of place (parks vs. zoos) and connectedness to nature (Table 2; ANOVA: $\chi_{(TYP:INS)}=14.19$, $df=1$, $p<0.001$), suggesting that connectedness to nature is positively related to concern for biodiversity for people surveyed in the zoos (i.e. zoo visitors), but not related to concern for biodiversity for people surveyed in parks (i.e., park users) (Fig.2).

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Table 2: Summary of the effect of independent variables on connectedness to nature and concern for biodiversity, in an urban context (i.e. in the two urban zoos and three urban parks). TYP: Group of respondents (zoo visitors and park users); HAB: Rural setting of place of residence; RUR: Rural setting of place of childhood; VIS: Frequency of visits to natural places; GAR: Owning a garden; AGE: Age; SEX: gender; INS: Connectedness to nature; CON: Perception of the role of the zoo as 'conservation'; CSI: Proportion of friends and relatives concerned for biodiversity. Levels of significance of ANOVAs are given (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). Some non-significant estimates are given when the effect of a single variable was not significant, but an interaction involving this variable was significant in the model. "--" refers to variables that were not included in the model.

Independent variables	Predicting connectedness to nature			Predicting concern for biodiversity		
	Estimates	Standard Errors	t values	Estimates	Standard Errors	t values
TYP	<i>Non significant – removed during stepwise model selection</i>			-0.656	0.538	-1.220
HAB	<i>Non significant – removed during stepwise model selection</i>			-1.190	0.105	-1.803
RUR	0.088	0.048	1.802	-0.130	0.081	-1.591
VIS	0.222	0.0486	4.564***	0.346	0.127	2.728
GAR	<i>Non significant – removed during stepwise model selection</i>			-		
AGE	0.196	0.049	4.012***	0.015	0.007	2.149
SEX	<i>Non significant – removed during stepwise model selection</i>			<i>Non significant – removed during stepwise model selection</i>		
INS	-			0.304	0.126	2.411***
CON	-			<i>Non significant – removed during stepwise model selection</i>		
CSI	-			0.797	0.146	5.467***
TYP (zoo visitors) : INS	-			0.354	0.094	3.768***
RUR : HAB	-			0.070	0.040	1.751
AGE : VIS	-			-0.007	0.003	-2.780**
CSI : INS	-			-0.153	0.039	-3.930***

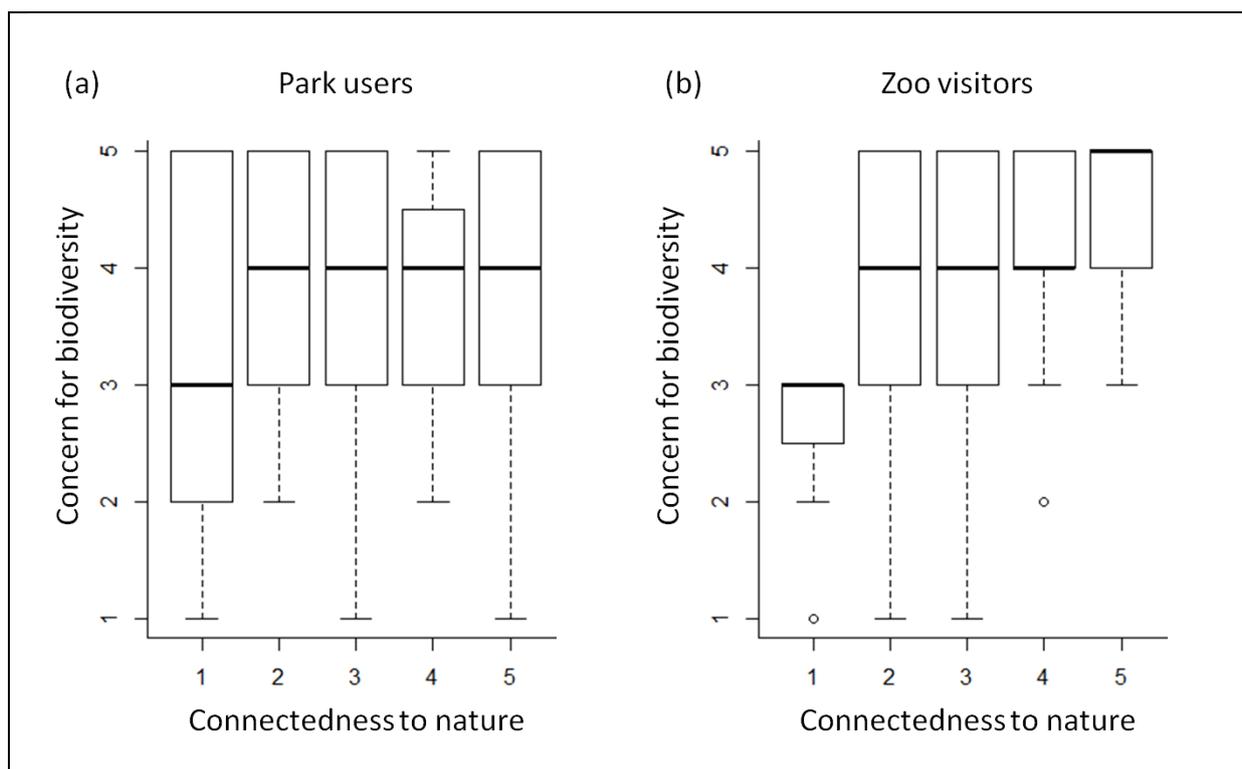


Figure 2: Mean levels of concern for biodiversity depending on connectedness to nature, for (a) park users, and (b) zoo visitors.

The equivalent analyses conducted on data from rural zoo visitors revealed that connectedness to nature was positively related to age (Table 3; ANOVA: $\chi_{(AGE)} = 10.10$, $df=1$, $p<0.001$) and frequency of visits to natural places (Table 3; ANOVA: $\chi_{(VIS)} = 10.78$, $df=1$, $p<0.001$, similarly as for people asked in urban places). Concern for biodiversity was also predicted by connectedness to nature (Table 3; ANOVA: $\chi_{(INS)} = 3.561$, $df=1$, $p=0.036$) and by the proportion of friends and relatives concerned for biodiversity (Table 3; ANOVA: $\chi_{(CSI)} = 8.354$, $df=1$, $p=0.001$). Again as in urban places, the effect of the proportion of friends and relatives concerned for biodiversity was also much larger than the effect of connectedness to nature.

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Table 3: Summary of the effect of independent variables on connectedness to nature and concern for biodiversity, in a rural context (i.e. respondents from the rural zoo). Variables are described in Table 2. Levels of significance of ANOVAs are given (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). Some non-significant estimates are given when the effect of a single variable was not significant, but an interaction involving this variable was significant in the model. “-“ refers to variables that were not included in the model.

Independent variables	Predicting connectedness to nature			Predicting concern for biodiversity		
	Estimates	Standard Errors	t values	Estimates	Standard Errors	t values
HAB	<i>Non significant – removed during stepwise model selection</i>			-0.160	0.079	-2.027*
RUR	<i>Non significant – removed during stepwise model selection</i>			<i>Non significant – removed during stepwise model selection</i>		
VIS	0.278	0.078	3.584***	<i>Non significant – removed during stepwise model selection</i>		
GAR	<i>Non significant – removed during stepwise model selection</i>			-		
AGE	0.269	0.078	3.469***	0.148	0.102	1.456
SEX	<i>Non significant – removed during stepwise model selection</i>			-0.152	0.159	-0.954
INS	-			0.176	0.083	2.121*
CON	-			0.181	0.078	2.316*
CSI	-			0.272	0.080	3.407**
CON : HAB	-			0.211	0.076	2.788**
CSI : HAB	-			0.183	0.078	2.344*
AGE : SEX (men)	-			-0.300	0.160	-1.874

4. Discussion

The results of this study contribute to a better understanding of the determinants of connectedness to nature and concern for biodiversity in urban people, as well as the potential effects of zoos in such relations.

Our results first suggest that a single zoo visit does not impact connectedness to nature, which seems consistent with previous literature (Bruni, Fraser, and Schultz 2008). However, contrary to our expectations, we showed that connectedness to nature did not either significantly vary depending on the number of zoo experiences. Further, our sample of zoo visitors did not show a significant difference in their connectedness to nature compared to

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our sample of park users. This result is not consistent with previous research, which found that zoo members showed higher levels of environmental identity and sense of connectedness than non members (Clayton, Fraser, and Burgess 2011; Clayton et al. 2014). This difference could be explained by the methods used to assess the sense of connectedness to nature: the measure of inclusion of nature in the self that we used is based on a single question assessing whether people feel cognitively interconnected to nature (Schultz 2001), while the measure of environmental identity relies on a list of questions assessing people's cognitive, affective and spiritual relationship to nature (Clayton 2003). It therefore remains possible that the effect of zoo visits on connectedness to nature differs depending on how we measure it. However, our study compared zoo-visitors with a specific sub-sample of non-zoo visitors who use urban parks, i.e. who were in contact with nature when they have been sampled. Our results suggest that people visiting urban parks and people visiting urban zoos do not differ in their connectedness to nature. Further research would help assess whether this connectedness to nature differs from people that do not frequent urban green spaces. Incidentally, our study confirms published results: connectedness with nature increases with individual practices toward nature (here based on the extent of visiting natural places; Mayer and Frantz 2004; Nisbet, Zelenski, and Murphy 2009; Cheng and Monroe 2012), and to childhood experience of nature (Chawla 1999). However, our results showed that connectedness to nature also increased with age, whereas previous studies found that age was not significantly correlated with any measure of connectedness to nature (e.g. Tam 2013).

The impact of the zoo visit on concern for biodiversity appears to be more complex: as for connectedness to nature, our results suggest that a single zoo visit does not impact concern for biodiversity; however, contrary to with connectedness to nature, the motives for the visit appeared to relate to the level of respondents' concern for biodiversity. Our hypothesis was that because expectations toward the zoo visit have impacts on learning in the zoo (Falk et al. 2007), i.e. on how people will receive the information, they will also, in turn, affect concern for biodiversity, depending on the information received. Our results are consistent with this hypothesis, since we found that respondent's level of concern for biodiversity varied depending on the motive for visiting the zoo. We found that visitors who expressed a

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desire to share the experience of the zoo (“Social”), to encounter animals (“Animals”) or to visit this particular place (“Place”) reported a higher level of concern for biodiversity, whereas visitors who were looking for a personal experience (“Self”) seemed to express a lower level of concern for biodiversity. Falk et al. (2007) showed that the visitors that were more likely to show significant changes in attitudes toward conservation were those who visited the zoo to satisfy their own curiosity and desire to learn (i.e. “explorers”), those who visited the zoo to satisfy the needs of others (i.e. “facilitators”) and “professional/hobbyists” (those with a specific interest, knowledge or training in an area related to the zoo). Thus, although we did not explore similar patterns of motivations for the zoo visit, our category “self” meets their “explorers” category, and “social” referred to similar aspects as their “facilitators” category. It is therefore surprising that we found contradictory results for the “self” motive related to a lower level of concern. This however confirms Falk et al. hypothesis (2007), that visitors’ prior knowledge, experience, interest and motivations for the visit (i.e. “Personal context”, *sensus* Falk and Dierking 2000) strongly impact their learning experience, through changes in attitudes toward conservation.

In addition, our results revealed that the quantitative experience of zoos (assessed through the number of visits) was positively related to concern for biodiversity, suggesting that people who have a stronger experience of zoos are more likely to express a high level of concern for biodiversity. Although we cannot affirm whether they feel more concerned because they have a stronger experience of zoos, or the other way round, we showed here that the zoo visit could help build attitudes toward conservation, or, at least, does not prevent people from being concerned for biodiversity. Previous studies showed that the zoo visit has strong social and emotional components (Reade and Waran 1996; Morgan and Hodgkinson 1999; Myers, Saunders, and Birjulin 2004; Clayton, Fraser, and Saunders 2009; Fraser et al. 2009), and that positive emotional experiences are related to higher willingness to support conservation and higher environmental concern (Kals, Schumacher, and Montada 1999; Allen 2002; Hayward and Rothenberg 2004; Myers, Saunders, and Birjulin 2004). Based on these studies, we propose that the zoo visit, when repeated, could effectively increase individual concern to biodiversity.

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Interesting and more complex results appeared regarding the effect of different combined variables on individual concern for biodiversity. First, concern for biodiversity was positively related to the connectedness to nature and to the proportion of friends and relatives concerned for biodiversity, but the relationship between concern and connectedness decreases for individuals in a more concerned social group. These results suggest that the social context plays an important role in the extent to which people are concerned for biodiversity: thus, when conservation social identity is high, people do not need to have developed a high sense of connectedness to nature to be concerned for biodiversity. Secondly, if the concern for biodiversity was positively related with connectedness to nature, this was clear for people surveyed in zoos, but not for people surveyed in parks (Fig. 2). In other words, if people have already a high sense of connectedness to nature, going to a park does not increase their declared concern for biodiversity; on the opposite, if they go to a zoo, they are more likely to declare a concern. Therefore, context seems to matter: the zoo context (and not park) can remind people that they are concerned regarding biodiversity conservation. Accordingly, Clayton et al. (2014) showed that among the 7182 zoo visitors they surveyed, sense of connectedness was associated with stronger cognitive and emotional responses to climate change. Our results suggest a priming effect of the zoo visit, i.e. effect that “involves some stimulation of people’s mental representations of social targets, events, or situations that then influences subsequent evaluations, judgments, or actions” (Molden 2014, p.6). The zoo visit could be a prime, between a prime stimulus, i.e. connectedness to nature, and a target stimulus, i.e. concern for biodiversity, as stated by the priming paradigm (Janiszewski and Wyer Jr. 2014).

In this study, the emphasis was on the urban context and most results thus apply to the urban setting. However, our analyses on the rural zoo visitors showed similarities on the variables that can affect connectedness to nature and concern for biodiversity. This therefore strengthens our results, and gives more confidence in any generalization: age and frequency of visits to natural places affect connectedness to nature, and conservation social identity and connectedness to nature affect concern for biodiversity, regardless of the urbanization context.

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This study however suffers from limitations, notably the fact that we did not conduct pre- and post-visit questionnaires with the same respondents, but instead we compared different samples of respondents between entrance and exit. Nevertheless, our results are consistent with previous literature. Moreover, our measure of connectedness to nature was based on a single-item measure, rather than a compilation of several items assessing sense of connectedness, as it is for environmental identity for instance (Clayton 2003). In addition, as a self-reported measure, it remains subject to bias (e.g. social desirability) and depends on whether people are aware of their own relationship to nature. We are aware that all our results are based on self-declarations, and that our interpretations should not go beyond these limitations. Finally, data were collected at a later time in the urban parks than in the zoos, which is why it remains possible that changes in the wider world could have affected some of park respondents' responses. However, because none important event regarding natural space uses and managements in France happened between the two periods of data collection, it remains unlikely that respondents' responses may have been affected.

5. Conclusion

To conclude, this study provides more thorough understanding of the potential impact of a zoo visit on individual concern for biodiversity and conservation. Visiting zoos does not increase individual connectedness to nature, but can make connected people more aware of biodiversity issues. The zoo visit may therefore act as a prime between identity and attitudes toward conservation. Zoos have a great potential in increasing concern for biodiversity for people who already have a high sense of connectedness to nature. Further research would allow understanding more thoroughly this process, in order to help zoos achieve more largely their education objectives on biodiversity for a broader audience.

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Chapter 4:

Does a zoo visit help reconnecting people with conservation issues?

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Introduction

In addition to the beneficial impacts on individual well-being (Howell et al. 2011), health (Mitchell and Popham 2008) or attention restoration (Kaplan and Kaplan 1989), restoring an intimate relationship between humans and nature has positive impacts for environmental issues, by fostering support for preserving biodiversity (Clayton and Kiliç 2013; Fielding, McDonald, and Louis 2008). Accordingly, more frequent contacts with nature were found to be associated with self-reported ecological behaviors among urban children (Collado et al. 2015). Additionally, S. Bögeholz (2006) argued that nature experiences are essential for the development of knowledge, values and actions in relation to the natural world, mainly because of their role in fostering assessment and judgment competences. Consequently, with the on-going biodiversity crisis, the extinction of experience has deleterious effects on pro-environmental behaviors (Soga and Gaston 2016a). It therefore appears important and useful to encourage people to support conservation, and foster pro-conservation behaviors, even if it does not reconnect them with nature. Consequently, reconnecting people with nature (focusing on opportunities and orientations, mostly) needs to be achieved in tandem with reconnecting people with conservation issues (focusing on pro-conservation attitudes and behaviors), to successfully promote experiences of nature and address conservation issues.

We showed in chapter 3 that repeated zoo visits were associated with higher levels of concern for biodiversity. Although we cannot state whether the repetition of zoo visits is the cause or the consequence of a higher level of concern for biodiversity, our results are consistent with Moss et al.'s (2015) statement, that zoo visits have implications for attitudinal change toward conserving the natural world. Indeed, a recent global survey across 26 zoos of 19 different countries showed that visitors' knowledge on biodiversity significantly increased after the zoo visit (Moss, Jensen, and Gusset 2015). Accordingly, we also showed in previous chapter that the zoo visit could be a primer for conservation attitudes, through connectedness to nature, in comparison to an urban park visit. However, Moss et al. (2016) showed in a more recent paper that biodiversity literacy of zoo visitors is a real, but relatively minor, factor in predicting both knowledge of actions to help protect biodiversity and self-reported pro-conservation behaviors. Their results therefore suggested

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that providing information is not enough for conservation action. Much research effort on pro-conservation behaviors have focused on self-reports (e.g. Moss, Jensen, and Gusset 2016; Bain et al. 2015) rather than assessing real pro-conservation behaviors, because of the difficulty in monitoring such behaviors (e.g. avoiding pesticides) in real-life settings, but also because of a lack of consensus on defining pro-conservation behaviors in the literature: although pro-environmental behaviors have been largely explored and defined (e.g. Steg and Vlek 2009), relatively little research has referred to “pro-conservation” behaviors so far. Moss et al. (2015) investigated zoo visitors’ knowledge of actions to help biodiversity (i.e. “an action they could take to help save animal species”), and categorized their responses using a coding system through which they gradually attributes points to the response depending on its degree of accuracy (i.e. from 0 for “action or behavior identified not relevant to conservation”, to 4 for “very specific identification of probiodiversity action of behavior that the respondent clearly states is a personal action or behavior”). However, such coding remained arbitrary in this study, since authors did not cite any scientific previous work to confirm their assumptions that one specific behavior is actually beneficial for biodiversity conservation or not.

One way to assess self-reported pro-conservation behaviors is to ask participants to list pro-conservation behaviors they are aware of and the extent to which they performed them lately (e.g. in Moss, Jensen, and Gusset 2016). Another way is to investigate the extent to which people would pay for the conservation of a species or an ecosystem, i.e. the willingness-to-pay (e.g. Balmford et al. 2004; Bateman et al. 2013; Togridou, Hovardas, and Pantis 2006; Zheng et al. 2013). However, relatively little research has measured willingness-to-pay for conservation through real monetary donations to conservations projects, to evaluate real pro-conservation behaviors. Most studies indeed relied on self-reported intentions to support conservation (Gunnthorsdottir 2001; Tisdell, Wilson, and Swarna Nantha 2006). Based on results from these studies, people are more willing to donate money and support conservation of species that are more charismatic, and more similar to humans (Martín-López, Montes, and Benayas 2007; DeKay and McClelland 1996; Gunnthorsdottir 2001; Plous 1993; Samples, Dixon, and Gowen 1986). Indeed, people seem to generally show a preference for these species, which is why animal collections are often biased toward

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these species in zoos, as well as in selecting species for conservation projects (Angulo et al. 2009; Ward et al. 1998). There has even been evidence of such preference bias among scholars, who disproportionately study fewer “ugly” species (e.g. native rodents and bats) (Fleming and Bateman 2016).

Attitudes toward animals indeed largely vary from one species to another. For instance, primates usually elicit positive emotions, mainly because of their similarities with humans (Plous 1993), while invertebrates are expected to elicit more fearful or aversive emotional responses (Kellert 1993). Similarly, zoo visitors are more willing to spend money, time and efforts to observe rare or charismatic species (Angulo et al. 2009; Moss and Esson 2010). We however highlighted in the previous chapter that although people mostly emphasized caged species displayed at the zoo (i.e. mostly exotic species, compared to uncaged wildlife when participating in a survey on their own), visitors seemed to perceive the urban biodiversity as well, but a procedure of self-reflective interview was necessary for them to acknowledge this perception.

Many zoos in the world have recently developed “animal adoption” programs, aiming to raise money to support conservation projects. These programs allow people to “adopt” an animal, in exchange of a monetary donation, for which they receive various benefits in return (e.g. newsletter of the zoo, free entrance ticket). The adoption of the animal allows the participant to experience a more intimate relationship with the animal, because s/he becomes his symbolic “god-father/mother”, and receives regular news of the animal. Vining suggested that providing people intimate animal-related experiences is a necessary step to engage them in conservation actions (Vining 2003). Accordingly, a recent survey on 3 588 U.S. zoo and aquarium visitors showed a significant, directional relationship between affective sense of connection with animals and self-reported pro-environmental behaviors (Grajal et al. 2016).

Therefore, we explored in manuscript 5 the willingness-to-pay for species conservation of participants in a zoo animal adoption program, through their monetary donations to the program, to extend results from studies relying on self-reported intentions to support. We therefore investigated whether people relied more on biological (e.g. level of threat,

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phylogenetic distance to humans) than on more affective (e.g. charisma) characteristics of the animals in their choice of animal and monetary donations to the program. In addition, we explored whether participants' choice of animal and donation were consistent with their attitudes toward the animals (i.e. emotional responses). Finally, we assessed the relationship between animal choice and more general characteristics of the participants, such as their past and current relationship to nature. These results allowed us to assess the contribution of zoos in reconnecting people with conservation issues, through the investigation of real pro-conservation behaviors (i.e. monetary donations to the program).

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Human preferences for species conservation: Animal charisma trumps endangered status

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Abstract

A good deal of research has recently focused on people's commitment to biodiversity conservation by investigating their "willingness-to-pay" (WTP). Because of the public's self-reported preferences for species that are more charismatic or similar to humans, conservation programs are often biased toward these species. Our study aimed to explore the determinants of WTP among 10 066 participants in a zoo conservation program. The program aims to raise money to support conservation programs and involves donating a sum of money to "adopt" an animal in the zoo. We explored whether participants were influenced by particular scientific characteristics of the animal (IUCN conservation status and phylogenetic distance from humans) or by more affect-related characteristics, such as the charisma of the animal.

We found that participants did not choose an animal to adopt because of the endangered status of the species, and did not donate more to endangered species than to other species. Instead, they were more likely to choose a charismatic species. However, surprisingly, those who chose a less charismatic species gave more money on average to the program than those who adopted more charismatic species, suggesting a higher level of commitment among the former.

These results therefore suggest that this type of conservation program may not be an effective way of reconnecting people with conservation issues related to endangered species. We therefore advise zoos to communicate more strongly on the level of threat to species and to increase the ratio of endangered over charismatic species in their animal adoption programs.

Key words: animal adoption program, charisma, conservation status, phylogenetic distance, willingness-to-pay, zoo.

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1. Introduction

The accelerating loss of biodiversity is now widely acknowledged, with a steep increase in the number of species listed as Critically Endangered (e.g. from 168 to 209 mammal species) or Endangered (e.g. from 31 to 810 amphibian species) from 1996 to 2015, according to the International Union for Conservation of Nature Red List of endangered species (IUCN 2015). Ambitious conservation policies depend on people's concern for biodiversity, which determines their commitment. One way of investigating their concern is to analyze their willingness-to-pay (WTP) (Balmford et al. 2004, Bateman et al. 2013, Togridou et al. 2006, Zheng et al. 2013). Most studies have focused on the value given to ecosystems (Balmford et al. 2004). Among the few studies that have explored the value given to species, all of them, to our knowledge, have relied on participants' self-reported hypothetical species choices or intentions to support a program (Gunnthorsdottir 2001, Tisdell et al. 2006), rather than on their actual behaviour (i.e. real money invested). For instance, based on hypothetical species choices and money allocation, Martín-López et al. (2007) found that affective factors (e.g. charisma) have more influence on WTP than ecological or scientific considerations. They also found that respondents with better knowledge of biodiversity and more experience of nature were more willing to donate for the conservation of non-charismatic species that were locally endangered (Martín-López et al. 2007). These results needed to be tested in real-life settings, with actual species valuations.

People also seem to have a preference for conserving animals that are similar to humans (DeKay & McClelland 1996, Gunnthorsdottir 2001, Plous 1993, Samples et al. 1986). The preference among humans for animal species similar to them has been formalized as the Similar Principle Theory (Plous 1993). This theory is supported by the findings of a research team in Australia, which showed that respondents appeared to favour the survival of mammals rather than birds or reptiles (Tisdell et al. 2006). Another study in the United States showed that physical characteristics (e.g. physical length) were better predictors of government spending decisions for conserving endangered species than more scientific characteristics, such as the level of threat or taxonomic distinctiveness (Metrick & Weitzman 1996). This prompts the hypothesis that many species' chances for survival depend as much on human preferences as on more biological requirements (e.g. minimum population size).

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In this study, we wanted to investigate WTP and its determinants more closely at the individual level, in a situation where money for species conservation is actually given. Among the numerous existing conservation programs, zoological institutions have been involved in both ex-situ (captive breeding) and in-situ programs (significant financial contributions) (Gusset & Dick 2011). However, the way zoos contribute to conservation is still controversial: for instance, zoos mostly display large-bodied vertebrates and less-threatened species (Balmford et al. 1995, Conde et al. 2011, Fa et al. 2014, Martin et al. 2014). One reason for this is the general public preference for large mammals and rare or charismatic species in zoos (Angulo et al. 2009, Ward et al. 1998). However, endangered species may not be charismatic, and vice versa, so that the relationship between zoo exhibits and biodiversity preservation can be complex. In any case, more information is needed on public preferences in zoos, and how zoos could integrate such preferences to connect the public with biodiversity preservation.

To support in-situ conservation programs, zoos have developed different strategies to raise money. One of them is the worldwide strategy of “Animal adoption” programs: people can donate a certain amount of money to the zoo; in return, they receive various benefits (e.g. the zoo's newsletter, meeting zoo keepers, free entrance tickets) and symbolically become the “god-fathers” or “god-mothers” of the animal(s) they chose. Such programs foster a more intimate and privileged relationship between participants and a particular animal, via its adoptive status, compared to non-participants who visit the zoo. However, emotional responses to animals vary widely between and within taxonomic groups (Myers et al. 2004). For instance, primates are more likely to elicit positive emotional responses, because of their close similarities with humans (Plous 1993); conversely, invertebrates are expected to elicit more fearful or aversive emotional responses (Kellert 1993).

Our study therefore aimed to explore people's willingness-to-pay for species conservation through their actual donations to a zoo animal adoption program, by (1) clarifying whether people consider biological characteristics (e.g. threat level, phylogenetic distance from humans) in their choice of animal and their willingness-to-pay; (2) assessing whether attitudes toward animals (e.g. emotional responses) are reflected in participants' support for their conservation; (3) exploring the impact of the donor's relationship with nature on their

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choice of an animal in the program. We assessed these relationships by exploring individual connectedness with nature (Inclusion of Nature in Self, see Schultz 2001) and childhood experiences of nature (Chawla 2007) according to how far they spent their childhood in a rural setting.

We are not aware of any previously published research on animal adoption in zoos, despite the relevance of such programs to species conservation. This study therefore makes an important contribution to zoo conservation programs, and will help to clarify the effectiveness of zoo conservation programs.

Based on previous research findings, we hypothesized (1) that the level of threat and the phylogenetic distance from humans, but also less scientific considerations (e.g. whether the species is charismatic or not) are significant factors in determining the choice of an animal and the amount donated per participant, with larger donations expected for species that are more threatened, more similar to humans and more charismatic; (2) that attitudes toward animals (i.e. emotional responses) reflect the support of participants for their conservation; (3) that a stronger sense of connection with nature and more experience of nature during childhood influence respondents' choices of animal towards species that are less charismatic and less similar to humans.

2. Materials and Methods

2.1 Animal Adoption program

The Paris Zoological Park (PZP) opened in 1934, but closed in 2008 for renovation. It reopened in April 2014, as an "immersive" zoo: the 15 ha Park is now divided into five different biozones, where the enclosures are designed to immerse the visitor in the animal's natural environment. Physical barriers were, as far as possible, either removed or kept out of sight (e.g. glass instead of fences).

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In late 2013, the PZP set up an animal adoption program allowing members of the public to adopt one or more animals living in the zoo, for conservation purposes. A list of 29 different named individual animals was proposed (see table 1), and adopters were free to donate as much money as they wanted. However, six amounts ranging from 15€ to 1 000€ were proposed as guidelines, with a sliding scale of benefits offered to the adopter in return. The money donated to the program can be deducted from income tax at a rate of 66% of the amount. The adoption lasts for one year, starting from the day of adoption.

Overall, the raw data from the program we had access to included the following variables for each adoption between December 2013 and February 2015: animal chosen, amount of money donated, participant's zip code, age, and the date of adoption. Because the program is explicitly presented as supporting in-situ conservation programs, we used the amount of money donated per person for a particular animal as a measure of their willingness-to-pay for the conservation of this species. These raw data represent 10 066 participants in the adoption program.

Secondly, we sent an email to all the program participants to invite them to fill in an online questionnaire, in French, about their experience with the program. We collected data for 6 months (February – September 2015), and received 2 134 completed questionnaires, which represents a 21.20% rate of participation in our survey.

2.2 Survey instrument

In the survey questionnaire, we investigated the components of the adoption, whether the participants visited the chosen animal in the zoo, the emotions they felt towards this animal in the zoo, and personal information on their relationships with nature (connectedness with nature, concern for biodiversity and how far they spent their childhood in a rural setting), their age and gender.

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2.3 Components of the adoption

We asked the participants whether they adopted the animal for themselves, for someone else or if they had received it as a gift. We recorded the number of adoptions and animal(s) each participant adopted, as well as the amount of money donated per animal. Finally, we asked the participant to rank nine different possible motivations for the adoption, from 1 – least important reason, to 9 –most important reason. The following nine reasons were listed randomly : “to support the zoo's conservation mission”, “to support the zoo's research mission”, “for the benefits”, “for tax relief”, “because I feel a connection with this animal”, “because I like the Paris zoo”, “to contribute to the renovation of the zoo”, “to raise someone's awareness”, “because the species is endangered”.

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Table 1: List of animals available for adoption, with given name, scientific name, taxonomic group, total number of adoptions and amount of money raised per animal (in Euros). The animals are shown in decreasing order of total adoptions.

Taxonomic group	Name, animal (<i>scientific name</i>)	Total number of adoptions	Amount of money raised for each animal (€)
Mammal	Aramis, a jaguar (<i>Panthera onca</i>)	1479	89 152
Mammal	Adeline, a West African giraffe (<i>Giraffa camelopardalis</i>)	1463	73 550
Mammal	Lena, a Scandinavian lynx (<i>Lynx lynx</i>)	999	62 935
Mammal	Diablo, the Spanish wolf (<i>Canis lupus signatus</i>)	822	41 466
Mammal	Nero, an African lion (<i>Panthera leo</i>)	785	40 640
Mammal	Diego, a European otter (<i>Lutra lutra</i>)	688	37 410
Mammal	Tinus, a manatee (<i>Trichechus manatus</i>)	466	28 065
Bird	Indigo, a hyacinth macaw (<i>Anodorhynchus hyacinthinus</i>)	367	18 310
Mammal	Patagonian puma (unnamed) (<i>Puma concolor</i>)	349	18 510
Mammal	Azufel, a greater bamboo lemur (<i>Prolemur simus</i>)	345	24 005
Mammal	Efatra, a crowned sifaka (<i>Propithecus coronatus</i>)	331	22 096
Mammal	Serdtsse, a Grévy's zebra (<i>Equus grevyi</i>)	312	13 670
Mammal	Zakko, a wolverine (<i>Gulo gulo</i>)	279	16 305
Mammal	Wami, a white rhinoceros (<i>Ceratotherium simum</i>)	269	19 195
Bird	Pigloo, a Humboldt penguin (<i>Spheniscus humboldti</i>)	259	15 306
Mammal	Luca, a common woolly monkey (<i>Lagothrix lagotricha</i>)	235	12 430
Mammal	Mojo, a southern pudu (<i>Pudu pudu</i>)	206	11 060
Amphibian	Tana, a false tomato frog (<i>Dyscophus guineti</i>)	185	7 969
Mammal	Tabitha, a giant anteater (<i>Myrmecophaga tridactyla</i>)	148	9 185
Mammal	Uyuni, a Guinea baboon (<i>Papio papio</i>)	138	8 978
Mammal	Zoe, a greater kudu (<i>Tragelaphus strepsiceros</i>)	120	5 217
Mammal	Quida, a lowland tapir (<i>Tapirus terrestris</i>)	113	6 555
Reptile	Gertrude, a European pond turtle (<i>Emys orbicularis orbicularis</i>)	110	8 622
Mammal	Portos, a South American sea lion (<i>Otaria flavescens</i>)	106	5 006
Arthropod	Tegu, a curly haired tarantula (<i>Brachypelma albopilosum</i>)	94	3 746
Reptile	Mandi, a Madagascar tree boa (<i>Sanzinia madagascariensis</i>)	91	3 387
Reptile	Leon, a panther chameleon (<i>Furcifer pardalis</i>)	84	3 310
Bird	Satory, a griffon vulture (<i>Gyps fulvus</i>)	60	5 041
Fish	Zyko, an arapaima (<i>Arapaima gigas</i>)	26	1 900

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2.4 Visits to the adopted animal and emotions felt

Participants were asked whether they had visited the zoo since the renovation, and whether they had had a chance to observe their chosen animal. For those who visited the zoo and met the adopted animal, we asked to what extent they felt each of a list of five positive emotions (Interest, Fascination, Pleasure, Pride and Joy) and five negative ones (Fear, Sadness, Anger, Worry and Shame), from 1-not at all, to 5-very much. We restricted the question related to emotions to those who had had a chance to observe the animal because we were interested in their emotional reaction to the animal in the zoo, rather than in their beliefs and emotional reactions towards the species in general. Positive and negative emotions were mixed and presented randomly for each participant.

2.5 Personal information

We used an adapted version of the Inclusion of Other in the Self (IOS) scale (Aron et al. 1992) to measure individual beliefs about how interconnected people feel with the natural world, via a series of overlapping circles labelled "nature" and "self" (Inclusion of Nature in Self scale, see Schultz 2001).

Participants were also asked to what extent they were worried about biodiversity, from 1-not at all, to 5-very much. We asked whether they spent their childhood in a rural or urban setting, from 1-very urbanized, to 5-very rural. Finally, we asked for the gender and provided six age categories (18-30, 31-40, 41-50, 51-60, 61-70 and over 70), which we recoded into a numerical scale of 1 to 6.

2.6 Biological and non-biological characteristics of the animals

We assessed two biological characteristics of the animals, as follows: (1) the level of threat to the species, according to the International Union for Conservation of Nature (IUCN) Red List, which we coded from 1 for least concern (LC), to 5 for critically endangered (CR) (IUCN 2015); (2) the phylogenetic distance from humans, obtained from <http://tolweb.org/tree>, which we coded from 1 for closest to humans (e.g. primates) to 9 for the more distant species (e.g. tarantula). This coding reflected the respective ranks of the species considered in relation to humans, rather than their theoretical phylogenetic distance from humans.

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In addition, we attributed two characteristic non-biological traits to each animal species. The first was the charisma of the species, which we identified by averaging the number of google searches (in France only) from January to December 2014. The second was the alphabetical order of the name given to the animals, from 1 for A (e.g. Aramis the jaguar) to 26 for Z (e.g. Zyko the arapaima), because the program's website lists the names of the 29 animals in alphabetical order. We ascertained from zoo staff that the animals were not named with any reference to the alphabetical order.

2.7 Statistical analysis

All the analyses were performed using R 3.0.2 (R Core Team 2013).

2.7.1 Effect of biological and non-biological characteristics of the animal on adoption choices, amounts of money donated and emotions felt for the animal

We found no significant correlation between the four characteristics of the animal considered (i.e. IUCN threat level, phylogenetic distance from humans, charisma according to google searches and alphabetical order of the name), using Pearson's correlation tests.

From the complete data set from the program, we then modelled the determinants of animal choice using linear regression. We assessed the proportion of adopters (ADP) of each of the 29 animal species studied as the response variable, and the IUCN threat level (THR), phylogenetic distance from humans (PHY), "google" charisma (CHA), alphabetical order of the name (ALP) and possible interactions between these variables as independent variables. We used model selection and model averaging methodology: models derived from the data were ranked using Akaike information criteria corrected for small sample size (AIC_c), and we selected only models with a $\Delta AIC < 4$ (Burnham et al. 2011). We calculated the Akaike weights (w_i ; probability that the i th model is actually the best approximating model among all the possible models). The relative importance (w_+) of each predictor variable was calculated by summing Akaike weights across the different models that the variable considered appeared in. Importance values range from 0 to 1, with larger values indicating greater importance relative to other variables. We reported parameter estimates (β) and associated standard errors for each variable, based on model averaging over all the models in the set (Burnham, Anderson, and Huyvaert 2011). The calculations were performed using the MuMIn 1.13.4 (Barton 2015) package for R 3.0.2 (R Core Team 2013).

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We used the same model selection and model averaging methodology to build up a second model to analyze the determinants of the amount of money donated. Here, we assessed the amount of money donated per person (INV) as the response variable and the same biological and non-biological variables (i.e. THR, PHY, CHA, ALP and possible interactions) as independent variables. For this analysis, we selected only the participants who had adopted a single animal (N=9 669), to avoid any bias due to multiple adoptions by a single participant. Finally, using the questionnaire data, we modelled the determinants of both positive and negative emotions toward the adopted animal using linear mixed-effects models. First, we assessed the average score of positive emotions felt for the animal (PEM) as the response variable, the same four variables (i.e. THR, PHY, CHA and ALP) as independent variables, and the participant as a random effect to control for multiple adoptions by a single person. The same model was run with the average score of negative emotions felt for the animal (NEM) as the response variable. For these two models, we only considered those who had adopted an animal for themselves, because we were interested in personal involvement in the adoption. Data on emotional scores were available for 511 people who adopted an animal for themselves. We used the 'nlme' 3.1-125 package (Pinheiro & Bates 2016).

2.7.2 Effect of background variables on animal choice in relation to biological and non-biological characteristics

Using the questionnaire data, we explored whether connectedness with nature and a rural setting during childhood had an effect on animal choice, in relation to phylogenetic distance from humans and "google" charisma. To do so, we used a linear mixed-effect model with phylogenetic distance from humans (PHY) as the response variable and connectedness with nature (INS) and rural setting during childhood (RUR) as independent variables. We applied a random effect to the participant variable. We performed the same linear mixed-effect model with "google" charisma (CHA) as the response variable.

3. Results

3.1 Participant profiles

Altogether, 10 066 different people took part in the program, adopting one or several animals (619 persons adopted more than one animal, usually two), resulting in a total of 10 929 adoptions by the end of February 2015. Most of the participants (99%) were living in France. 30% were from Paris, and 16.7% of these were living in the 12th arrondissement in Paris (i.e. where the zoo is located). Given that in France in 2013, Parisians represented 3.43% of the French population, and people living in the 12th arrondissement in Paris represented 6.49% of Parisians (INSEE 2013), the proportion of Parisians and 12th arrondissement inhabitants in our sample was relatively large compared to the population in France.

A total of 613 021.36€ had been collected by the end of February 2015, and most participants donated between 30 and 74€ (a minimum donation of 30€ was necessary to receive the program benefits) (Fig. 1).

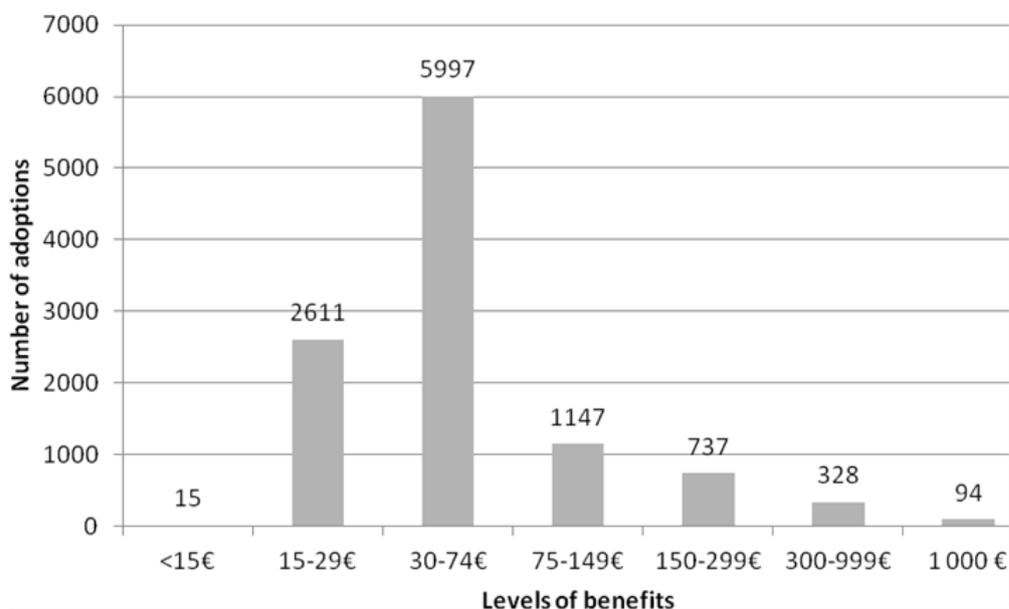


Figure 1: Numbers of adoptions for each level of benefits offered by the program. Below 15€, the participant did not receive any benefit in return for participating.

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Among the 2 134 respondents to our questionnaire, 868 had adopted an animal for themselves, 826 as a gift to someone else, and 243 had received the adoption as a gift. The remaining 141 respondents were participants who combined some of the previous three types of adoption. 1313 respondents had visited the zoo since it reopened (61.5%) and 1533 had visited the zoo before its renovation (71.8%). 1254 owned a pet (58.8 %), which is similar to the proportion for the French population as a whole (FACCO/TNS SOFRES 2015). 784 respondents were involved in environmental or animal protection organizations (36.7%), which is a much higher proportion than for the French population as a whole (11%) (European Commission 2013).

Based on the three most important reasons cited for participating, respondents mostly adopted an animal for themselves or as a gift to support the zoo's conservation mission (25.09%), to support the zoo's research mission (15.45%), because they felt a connection with the animal they chose (12.66%), to contribute to the zoo's renovation (12.22%) and because the species they chose is endangered (11.43%). The remaining four reasons – because they like the zoo, to sensitize someone, for the benefits and for tax relief – accounted for 9.89%, 9.12%, 2.42% and 1.73% respectively.

3.2 Effect of biological and non-biological characteristics of the animal on the adoption choice, amount of money donated and emotions felt for the animal

3.2.1 Proportion of adopters per animal

Our focus was on the relative importance values (w_+) of the four independent variables in predicting the proportion of adopters per animal, rather than on ranking all the possible model combinations for the four independent variables (see table 2). According to the model averaging, the highest importance value ($w_+ = 1.00$) was assigned to the alphabetical order and “google” charisma variables. These variables appeared in the top two models (table 2).

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Table 2: Rankings by Akaike's information criterion correction for small sample size (AIC_c) of top linear regression models predicting the proportion of adopters per animal and those predicting the amount of money donated per animal (^{a,b}).

Analysis	Model	df	AIC_c	Δ_i	w_i
Proportion of adopters per animal	ALP CHA	4	67.22	0.00	0.74
	ALP CHA PHY	5	69.32	2.10	0.26
Amount of money donated per animal	CHA PHY (CHA*PHY)	5	26565.11	0.00	0.30
	CHA PHY	4	26566.39	1.27	0.16
	ALP CHA PHY (CHA*PHY)	6	26566.54	1.43	0.15
	ALP CHA PHY (ALP*PHY) (CHA*PHY)	7	26566.55	1.44	0.15
	ALP CHA PHY (ALP*PHY)	6	26568.03	2.92	0.07
	ALP CHA PHY	5	26568.38	3.27	0.06
	ALP CHA PHY (ALP*CHA) (ALP*PHY) (CHA*PHY)	8	26568.39	3.28	0.06
ALP CHA PHY (ALP*CHA) (CHA*PHY)	7	26568.52	3.41	0.05	

^a Δ_i is the difference in AIC_c value between the i th and top-ranked model and w_i is the Akaike weight.

^b Four independent variables were modelled (ALP: Alphabetical order of animal names; CHA: "Google" charisma of the species; PHY: Phylogenetic distance from humans; THR: IUCN threat level for the species; interactions between variables are modelled with *).

The more charismatic the species was, the more it was chosen by participants (table 3). The alphabetical order had a negative effect on the proportion of adopters per animal, suggesting that participants were more likely to choose an animal whose name started with a letter near the top of the alphabet than further down in the alphabet. This suggests that participants were more likely to choose an animal at the top of the website page, which gives the names of the animals in alphabetical order, than to choose animals from the bottom of the list. On the other hand, we found that the IUCN threat level and the animal's phylogenetic distance from humans had no effect on the proportion of adopters per animal.

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Table 3: Relative importance (w_+) of variables in predicting the proportion of adopters and amount of money per animal, based on linear regression analysis (^{a,b}).

Variable	Proportion of adopters per animal				Amount of money per animal			
	w_+	Estimates	Std. Error	P-value	w_+	Estimates	Std. Error	P-value
ALP	1.00	-0.49	0.14	<0.001	0.54	-0.01	0.01	0.58
CHA	1.00	0.43	0.14	0.003	1.00	-0.05	0.02	0.02
PHY	0.26	-0.12	0.14	0.415	1.00	-0.05	0.02	0.03
ALP*PHY	-	-	-	-	0.28	0.02	0.01	0.15
CHA*PHY	-	-	-	-	0.71	-0.05	0.02	0.06
ALP*CHA	-	-	-	-	0.11	0.01	0.01	0.78

^a The estimates, standard errors and p-values are also given for the high-importance variables.

^b Variables are defined in table 2.

3.2.2 Amount of money donated per animal

According to the model averaging, the highest importance value ($w_+ = 1.00$) was assigned to the variables for “google” charisma and phylogenetic distance from humans. These variables appeared in the top eight models (table 2). The more charismatic the species, the smaller the amount of money donated; the smaller the phylogenetic distance from humans, the greater the amount of money donated (table 3). The importance of the interaction between “google” charisma and phylogenetic distance from humans was also high, with w_+ s of 0.71 (table 3), which suggests that the greater the phylogenetic distance, the stronger the negative effect of “google” charisma becomes.

3.2.3 Emotions felt per animal

These analyses were limited to respondents who had visited the zoo since the renovation and had seen the animal they adopted for themselves or for others (i.e. 511 people).

We found that the IUCN threat level was negatively correlated with positive emotions felt for the animal ($\beta = -0.14$, $SE = 0.04$, $p = 0.001$), and positively correlated with negative emotions felt for the animal ($\beta = 0.09$, $SE = 0.03$, $p = 0.01$). No correlation was observed between other

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variables (phylogenetic distance from humans and alphabetical order) and either positive or negative emotions felt for the animals. Interactions were not significant in the models. These results suggest that IUCN threat level had a significant effect in determining the emotions felt for the animal, lowering positive emotions and strengthening negative emotions.

3.3 Effect of background personal characteristics on animal choice in relation to its biological and non-biological characteristics

We found no effect of connectedness with nature on participants' choices in favour of charismatic or phylogenetically distant species ($\beta=0.03$, $SE=0.03$, $p=0.32$; and $\beta=0.01$, $SE=0.03$, $p=0.94$ respectively). A more rural childhood was negatively correlated with the charisma of animals adopted, and positively correlated with their phylogenetic distance from humans ($\beta=-0.09$, $SE=0.04$, $p=0.01$; and $\beta=0.08$, $SE=0.04$, $p=0.02$ respectively). Interactions were non-significant in all these analyses. These results suggest that participants who spent their childhood in a rural setting were more likely to choose species that are less charismatic and phylogenetically more distant from humans.

4. Discussion

The results of this study confirm some of our working hypotheses, but surprisingly did not support others, particularly in relation to the charisma and endangered status of the species that participants chose to support. This study also suggests that individual relationships with nature tend to gear people's support of conservation towards species that are less charismatic and less similar to humans. We discuss these results below.

4.1 Technical effects

Surprisingly, we found that the alphabetical order of the names given to animals had a strong effect on animal choice. However, charismatic species were not significantly high in the alphabetical order. Because animals were listed by name in alphabetical order on the adoption program's website, this result therefore suggests that many participants may have

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selected the first available animals on the website page. Our interpretation is that the alphabetical order effect shows that people are not willing to spend much time on choosing the species they wish to support, but go for the first animal displayed once they have decided to support a conservation program. Does this indicate a lack of interest, or a feeling of ignorance? Further studies are needed to clarify this point.

4.2 Similarity effect

As expected, similarity to humans was found to influence WTP for species conservation: although no influence of similarity on animal choice was found, participants donated more on average for species that are phylogenetically closer to humans. This result is consistent with previous research giving credit to the Similarity Principle in conservation support (DeKay & McClelland 1996, Gunnthorsdottir 2001, Plous 1993, Samples et al. 1986).

4.3 Charisma effects

Our major result revealed complex effects of animal charisma on support for conservation. We showed first that the level of charisma had a positive impact on animal choice, but a negative impact on the amount donated, or WTP. The positive effect of charisma on animal choice is consistent with previous literature (Bennett et al. 2015, Skibins et al. 2013); however, its negative effect on WTP is striking, and suggests that those who adopted less charismatic species probably engage more strongly with species conservation, acknowledging the strong selection biases that might exist in favour of charismatic species. In other words, committed people might tend to make a strategic choice, anticipating that some non-charismatic species are likely to attract little support and deciding to compensate accordingly.

4.4 Effects of species conservation status

Another unexpected result is the lack of any effect of the species conservation status on animals chosen and amounts donated. This indicates that people taking part in a program presented as dedicated to species conservation do not consider endangered status criteria when choosing an animal to adopt and deciding on the amount they wish to donate. This

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was even more surprising given the high proportion of participants who reported being involved in organizations for environmental and animal protection.

On the other hand, we found that the conservation status of the animal had a significant effect in determining emotional responses towards it, suggesting that people who adopted more threatened species were more likely to express negative emotions, and the animals they adopted less likely to elicit positive emotions, than other respondents towards the less threatened species they adopted. Linking this to the result on willingness-to-pay suggests that emotional responses towards animals did not reflect participants' willingness-to-pay for species conservation.

A potential limitation of this result is that we were unsure whether the participant visited the animal after the adoption process, or whether the visit to the animal elicited the desire to adopt it. Nevertheless, all the species are displayed similarly in the zoo, regardless of how endangered they are. Information on conservation status is equally available for all the species (e.g. on the program website and on the species information panels in the zoo). Finally, the more threatened species available for adoption belonged to different taxonomic groups, with primates, which are usually more positively perceived by visitors because of their similarities to humans (Plous 1993), particularly well represented. We are also aware that although those who responded to the questionnaire were relatively similar in age to the program participants as a whole, those who did not complete the questionnaire survey might have had different attitudes towards the animals.

4.5 Effects of participants' personal characteristics

As expected, our results suggest that childhood experiences of nature have a strong influence on the choice of animals, with people with more rural experiences during childhood choosing species that are less charismatic and less similar to humans. Indeed, childhood experiences of nature have been found to have a profound effect on the way people experience nature in adulthood (Chawla 2007), and previous research has also noted that experience of nature tends to influence willingness-to-pay for less charismatic species (Martín-López et al. 2007). We did not find any effect of connectedness with nature on the choice of animals to adopt, although it has been suggested that this is associated with

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childhood experiences of nature (Chawla 2007). This could be explained by the fact that we assessed connectedness with nature through a single question, and relied on self-reporting by participants of a conscious personal relationship with nature.

5. Conclusion

Overall, our survey based on actual monetary donations produced results similar to those from a previous survey based on hypothetical animal choices and willingness-to-pay for species conservation (Martín-López et al. 2007). Our study also indicates that people's choices of animals to adopt and their willingness-to-pay were mostly driven by affect-related motivations and arbitrary influences, rather than by more ecological considerations such as the endangered status of a species. We therefore suggest that people participating in such conservation programs mostly look for the intimate relationships they allow with individual animals.

Our work has several implications for zoo strategies concerning adoption programs for conservation and the choice of animals proposed for adoption: similarity with humans matters, but endangered status is a minor concern; with regard to species charisma, zoos could develop a more strategic targeting approach: more people adopting charismatic species, or larger individual donations for non-charismatic species from committed people. Zoos might therefore consider developing a discourse on the importance of species in ecosystem functioning or on adaptation to global change, which is an important way of reconnecting people with biodiversity. Finally, zoos should be aware of the importance of certain choices made (especially regarding the alphabetical order used to present their animals) in presenting their strategic objectives.

Finally, the consequences of our results for the conservation policies of zoos are complex, because the effectiveness of adoption programs as a way of raising conservation awareness remains uncertain. We strongly advise managers of species conservation program to provide potential participants with more in-depth information about levels of threat to species, and perhaps to considerably increase the proportion of more threatened and less charismatic species in their selection of animals for adoption programs. The question certainly arises as

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to whether a large amount of small donations for charismatic species would be more effective than fewer but larger donations for less charismatic species. In parallel with adoption programs, we recommend more studies on how animal collections could be optimized to maximize ex-situ conservation in zoos, since reconciling conservation with their own financial viability requires zoos to work with both charismatic and threatened species (Delmas 2014). Nevertheless, to raise people's awareness about conservation issues and because of the urgent need to conserve more threatened but less charismatic species, more recommendations are needed on displaying species according to their charisma and conservation status respectively.

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General discussion, limitations and perspectives

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General discussion

In this PhD project, I explored the potential of zoos in indirectly contributing to biodiversity conservation, through helping reconnect people to nature, especially for urban dwellers, that are considered as increasingly disconnected from nature. Such hypothesis relies on the fact that even if nature (both animals and landscape) displayed in the zoo is entirely artificial, visitors can experience it, through emotions, attachment and shared experiences with others. Nature presented in zoos, either exotic or local, could allow visitors' immersion in "something else" than their everyday lives. This disconnection from daily life could then lead to connection to something else.

Zoos seem to be considered as recreational places

Historical changes on perspectives and objectives of zoos were accompanied by modifications of their landscape design, toward greener places. This is the case for the Menagerie of Jardin des Plantes, which used to display a large variety and number of animals in cages full of concrete and devoid of vegetation, and which is now composed of fewer species in larger and more naturalistic enclosures. Nevertheless, vegetation in the zoo is entirely managed and part of the scenery. This is also the case for displayed animal collections, for which the emphasis is on species that are exotic, or charismatic, to attract visitors, at the expense of species that are more local or less known, even if sometimes more threatened (Conde et al. 2011; Frynta et al. 2013). Indeed, charismatic species are often used to sensitize the public to biodiversity conservation (Skibins, Powell, and Hallo 2013; Fa et al. 2014), and exotic animal species are sometimes better acknowledged than local species (Ballouard, Brischoux, and Bonnet 2011; Lindemann-Matthies 2005). In zoos, visitors seem to spend more time in front of exhibits that show mammals or charismatic species compared to other taxa and less charismatic species (Moss and Esson 2010). Similarly, zoo visitors are more attracted by rare species compared to more common ones (Angulo et al. 2009). Finally, zoos are places that attract large numbers of visitors (e.g. one million visitors in Beauval zoo in 2012 and more than one million in Paris Zoological Park in 2014 (Les Zoos dans le Monde 2015; ZooParc de Beauval 2016)): at very busy periods in Paris Zoological

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Park, some visitors associated the ambience perceived at the zoo with the ambience of public spaces like funfairs. When asked specifically about their motivations to go to the zoo, visitors mostly mentioned recreational aspects, saying that they mostly wish to spend a nice moment in family or with friends (as mentioned already by Reade and Waran 1996). The recreational aspect of the zoo visit is indeed largely highlighted in zoo websites, even if the words “entertainment” or “recreation” do not often appear (Carr and Cohen 2011). Moreover, zoos are institutions that attract people, whatever their motive for the visit, from very diverse backgrounds. The three zoos we surveyed indeed attract a very diverse population: on the 446 zoo visitors we approached, 27.80% were employees, 27.13% were managers, 17.16% were retired people, 8.07% were unemployed (including students), 7.62% were artisans, and, to a lesser extent, 4.71% were intermediary professions, 3.36% workers and 0.67% farmers.

Therefore, if zoos can be considered as natural places, they are nevertheless not devoid of any human presence, and “nature” at the zoo is not autonomous, but entirely managed.

Animals and zoos are sources of emotions

Even if the primary goal for visiting the zoo appears to be entertainment, visitors mostly visit zoos to closely encounter real animals (Rabb 2004). Animals are the key element of the zoo visit: they elicit visitors’ interest, which can then favor willingness to learn about the species and awareness of the importance of preserving the environment; animals symbolize an elsewhere, even more important when they are exotic and charismatic; they also elicit various emotional responses.

A preliminary survey was conducted by L. Germain (Master student) in Spring 2013, and involved 84 visitors exiting the Menagerie of Jardin des Plantes. He showed that exiting visitors felt higher levels of positive emotions (interest, pleasure, fascination, joy and pride) than negative emotions (sadness, anxiety, shame, fear and anger) toward the animals. The large survey I detailed in chapter 3, which targeted the persons who adopted an animal through Paris Zoological Park, confirmed the existence of emotions toward animals: on average, adopters expressed more positive emotions than negative emotions toward the animals they adopted. Emotional responses toward the animals could be used by some

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people as a way to express empathy toward them, although the zoo display does not necessarily promote this attitude: Veronique Servais (2012) indeed stressed that the impoverished environments of the zoo and the absence of an appropriate knowledge of the natural history of a given species could complicate perception of the links between behaviors and the environment that have shaped them or that are related to, whereas, as she underlined, this perception is precisely the element that favors empathy. More specifically, some people identify more or less easily to animals. Identification to animals is particularly easy with primates, because of their strong similarities with humans (Servais 2012).

Emotional responses toward animals are often shared among visitors, either within a single group, or with unknown visitors. Susan Clayton and colleagues (2009) indeed noted that the majority of conversations of visitors when facing an exhibit aim to share their impressions toward animals with other members of the group. Fraser et al. (2009) proposed that the sharing of emotions favors social interactions and contributes to the process of social cohesion in the groups of teenagers they surveyed. More generally, the survey mentioned in chapter 2 and that focused on the soundscape perception showed that emotional responses toward animals can even be shared between unknown visitors: when a person exclaims because s/he finally spotted the animal in the exhibit, or because s/he observed a surprising behavior, the group starts to move and interact, and the experience is thus shared. Indeed, social and emotional dimensions of the zoo visit have largely been acknowledged (Reade and Waran 1996; Morgan and Hodgkinson 1999; Myers, Saunders, and Birjulin 2004; Clayton, Fraser, and Saunders 2009; Fraser et al. 2009), notably because of the rich and diverse positive emotional experiences zoos provide. Moreover, there have been evidence that the persons who experience positive emotions toward captive animals are also those with stronger levels of environmental concern, and stronger support for conservation projects (Kals, Schumacher, and Montada 1999; Allen 2002; Hayward and Rothenberg 2004; Myers, Saunders, and Birjulin 2004). Acknowledging the emotional dimension of the zoo visit is therefore fundamental for conservation purposes.

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Animals and zoos are sources of attachment

In zoos, attachment exists in different forms. First, attachment to a particular individual animal, can favor willingness to visit the zoo to specifically visit this individual. For instance, Nenette is a female Orangutan at the Menagerie of Jardin des Plantes, that many visitors know and enjoy visiting her (personal observation, 2014), and she was the focus of a documentary film (Philibert 2010). Another form of attachment concerns a given zoo, for persons who had one or several particular experiences in this particular place (for instance, a memory of a walk on dromedaries' back in Paris Zoological Park, mentioned by two women in their sixties, during their childhood). Finally, some people may be attached to the experience of zoo visit in general, like people who often visited zoos with their parents during childhood, and who then go back to the zoo with their own children. For them, the zoo visit appears to be an important component of their childhood, which contributed to the construct of an identity they wish to share and transmit to their own children.

One particular case of attachment to a particular zoo animal might be characterized by its "adoption". Many zoos propose to "adopt", i.e. become the "godfather/mother", of a particular individual animal at the zoo, through a monetary donation, in exchange to benefits that varies according to the amount of money invested. Such adoption programs are most of the time announced as programs aiming to raise money for conservation (of the adopted animals, or of animals in general). Through these programs, large efforts are made to individualize and even sometimes anthropomorphize the animal, by giving them a surname. In Paris Zoological Park, 29 different animals can be adopted. The survey we referred to in chapter 3, and which focused on 2134 adopters recently showed that causes of adoptions are various, like helping the zoo conservation mission, the zoo research mission, or because they feel a sense of connection with the given animal. Many participants were Parisians (30%), and among Parisians, inhabitants of the 12th arrondissement (16.7%), where the zoo is located: this is particularly high compared to the proportion of Parisians in France (3.43%), and people living in the 12th arrondissement in Paris (6.49%) (INSEE 2013). This observation highlights the attachment some people can feel toward the zoo, as well as toward the animals that they will be able to visit more easily. The surveyed adopters sometimes mentioned a privileged relationship with the animal that they even sometimes anthropomorphize: for instance, a woman in her thirties mentioned that she really intended

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to “*meet Aramis [the jaguar] and his friends very soon!*”, or another woman in her sixties who hoped that her animal finally “*got a wife*”. Some people even go further and appropriate the adopted animal, by naming it “*godchild*” (or for instance “*my jaguar*”): a woman of about 50 years old explained that “*accompanied by [her] grandchildren, [she was] curious to see [her] godchild and her baby giraffe*”. Such program has therefore the potential to foster an affective sense of connection with animals, which has been found to positively relate to certainty that climate change is happening, level of concern about climate change, perception of effectiveness in personally addressing climate change (Luebke et al. 2012) and self-reported pro-environmental behaviors that address climate change (Grajal et al. 2016). However, the deeper analysis of participants choice of animal and amount of money invested in the program revealed that no attention was given to the level of threat of the animal: species that were more threatened were not more adopted, and did not raise on average more money than other species. On the contrary, participants seemed to choose largely more charismatic species, like the giraffe or the jaguar for instance. Nevertheless and interestingly, the less charismatic species raised on average more money per person than more charismatic species, which suggests that the persons who adopted less charismatic species were more informed about potential bias due to attraction for charismatic species, and that they could have adjusted their financial contribution in consequence. Finally, participants also seemed to choose more species that are phylogenetically closer to humans (e.g. primates). Much research effort should focus on people’s willingness to pay for species conservation, but our results raise questions regarding the efficiency of a program explicitly dedicated to species conservation on reconnection of people with conservation issues.

Animals and zoos allow people’s immersion in an “elsewhere”

As previously mentioned, zoo captive animals are more often exotic and charismatic species. In recent zoos (e.g. Paris Zoological Park), the environment within which animals are displayed mimics as much as possible their natural environment, in order to immerse the public in an elsewhere (Coe 1985). For instance, at the Paris Zoological Park the giraffe exhibit recalls African savannah, whereas the tropical greenhouse evokes the environment of Guyana and Madagascar, with their luxuriant fauna and flora. Beyond the displayed species, the zoo landscape is designed to bring visitors in a “natural” world, based on the

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idea that wild animals cannot integrate the artificial world that weaves our everyday lives and that they occupy the desert spaces devoid of humans (Cosson 2007).

However, the zoo visit does not always allow a solitary encounter with the animals in their natural environment; visitors may not even be looking for such solitary encounter, and instead visit zoos with family or friends, and navigate throughout the zoo among many other visitors. Yet, the visit seems to allow an escape, as suggested in the soundscape survey we focused on in chapter 2. This anthropological study aimed to characterize the auditory ambience of zoo visit experienced by 20 volunteers. Results showed that three types of sounds were noticed in the zoo ambience: human (e.g. children shouting, people talking), mechanical (e.g. engines, traffic noise) and natural sounds, from captive species and to a larger extent from non-captive species. Animals that participants heard comprised mostly birds (before primates), and often urban non captive species like pigeons or sparrows, which do not belong to the zoo animal collection. This unexpected result suggests that even if zoos display captive species, ordinary and urban biodiversity that is present in these places contributes as well to their ambience (at least auditory). A captive animal that vocalizes can mobilize the attention of visitors who then try to locate the source of the heard sound; this effort of concentration could help visitors to ignore any other source of sound, like human voices or city noises, to immerse in the “natural” environment of the targeted animal, and to disconnect from their daily urban routine. Nevertheless, non captive biodiversity that can be observed in zoos, and whose presence seems actually perceived by visitors, apparently contributes in settling visitors in a more local natural place. These results thus suggests that although zoos allow an encounter with an “exotic” nature, they also place visitors within a natural environment that is more local and closer to what people experience (or not) in their everyday lives.

Are zoos places for reconnection?

Zoos therefore offer particular opportunities to experience nature, in an artificially created nature that can however be as much exotic as local. Nevertheless, a direct reconnection to “nature” through the zoo remains uncertain; first because displaying captive animals could on the contrary reinforce the idea of separation between humans and nature; then because showing exotic species could not help people to reconnect with their surrounding natural

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world, whereas it is nowadays necessary to raise people's awareness of biodiversity that surrounds them and the importance of preserving it. Moreover, studies that focused on how zoos could promote sense of connection to nature gave contrasting results: Bruni et al. (2008) proposed that sense of connection to nature does not change consciously during a visit, but that it could happen unconsciously. However, the survey we mentioned on in chapter 3 and which focused on 446 zoo visitors of three French zoos suggested at the opposite that repeated zoo visits did not influence sense of connection to nature.

Overall results that are presented in this manuscript however suggest that the zoo visit allows visitors to feel an escape, a disconnection from a daily urban routine. For visitors experiencing it, zoos are probably places that allow mental restoration. Moreover, zoos can contribute in reconnecting people to nature and conservation issues in a very indirect way. First, we saw that zoos are very popular places, visited by diverse people, with a high proportion of children. Acknowledging the importance of childhood in the construct of an environmental identity and care for nature, zoos have a privileged position toward education to conservation and nature experiences. Second, the zoo visit has a large social component, through numerous positive social interactions that animals favor. Such positive social interactions with nature actively participate in the construct of an individual relationship to nature (Chawla 1988). Finally, the zoo is a source of various forms of attachment, which can lead to a sense of belonging to a place or a community, which in turn can be a source of commitment to preserving the landscape (Lokocz, Ryan, and Sadler 2011). Zoological parks could thus be mediators toward new relationships to nature and biodiversity conservation, but for reasons that are probably more subtle than what the missions attributed to zoos imply.

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Limitations

This project obviously has limitations, and any generalization of the results to the entire population must be tentative. First of all, the entire project was restricted to three French zoos that belong to the French national Museum of Natural History. Consequently, they may not be representative of other zoos in France. Besides, two of the zoos were located in Paris, so we can reasonably think that a large proportion of our sample contains inhabitants of Paris, and thus very urban dwellers, who may not be representative of other French inhabitants. However, the three targeted zoos differed in size, location and type of exhibitions, allowing us to collect data in different zoo contexts.

Then, data collections were conducted during limited periods of time, mostly during spring and summer seasons. Therefore, it is possible that people visiting zoos during winter or fall seasons may differ from those we surveyed at spring and summer. Similarly, data collection in Paris Zoological Park was conducted shortly after the reopening date of the park; the novelty of the zoo closed for many years for renovation thus attracted many people at the beginning. However, a significant number of animals were not arrived yet at the reopening, arousing many visitors' dissatisfaction and frustration. We did not explore visitors' satisfaction, so it should not bias our data regarding this point; it is nevertheless worth mentioning this as a potential limitation of our study.

In addition, except for our study on the animal adoption program, our sample size of zoo respondents was relatively low. This is particularly true for the two anthropological surveys we conducted (i.e. 38 groups of visitors for the preliminary survey on the zoo visit experience, and 20 participants for the self-confrontation interviews on perception of soundscape).

Moreover, analysis of qualitative data remains subject to personal interpretation, and it is important to keep in mind that personal beliefs of the researcher may have impacted his/her interpretation. Similarly, the data we collected from both questionnaires and interviews are self-reports, so we cannot ascertain for sure that respondents did not lie by giving answers s/he believed were more socially acceptable (i.e. social desirability bias).

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Consequently, we do not pretend here that our results are generalizable to the overall population, but instead, they help clarify whether zoos have the potential for reconnecting people with nature and conservation issues, and provide perspectives for future research or landscape management strategies to reduce the extinction of experience.

Perspectives

The results of this project have direct implications for the three surveyed zoos, and, to a broader level, for a wide range of disciplines, from zoo design and education to landscape management and conservation.

First, we advise managers of the surveyed zoos, as well as of zoos in general, to develop tools for increasing urban biodiversity in zoos, as it could be a favored place for people to perceive the urban biodiversity. Along with increasing their urban biodiversity, the zoo educators should also inform more strongly visitors on urban biodiversity, to raise people's awareness and appeal for the natural world they experience every day. Observations of visitors' behaviors toward the urban biodiversity in zoos, e.g. observation of visitors' interactions with urban avifauna using the same protocol as Skandrani et al. (2015), could help monitor visitors' interest and attitude toward urban biodiversity. Similarly, a questionnaire survey assessing visitors' knowledge on urban biodiversity could help testing the efficiency of the zoo educational program focused on urban biodiversity. We also advise zoo educators to strengthen actual and develop new forms of communication on conservation, especially on less known, more common and more endangered species, because participants of a conservation program did not appear to prefer to support the more endangered species, but instead preferred to support more charismatic species. As charismatic species tend to be more profitable for raising money (Martín-López, Montes, and Benayas 2007), a compromise should be found between charismatic and less charismatic but more endangered species, to collect large amounts of money to support conservation (Delmas 2014), but also increase people's awareness. Because participants of the zoo animal adoption program were only surveyed once, we were not able to observe program impacts on participants' attitude toward animals and conservation for instance;

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therefore, more research is needed to monitor participants' attitudes and engagement toward conservation, through pre- and post-participation questionnaire surveys for instance. Such survey would be strongly beneficial, and relatively easy to implement, by sending participants a questionnaire at the time of adoption, and a follow-up questionnaire survey after a few months of adoption. In addition, the "adoption" of a zoo animal suggests an already existing strong bond with the animal, or the potential emergence of it. This could lead participants to express more empathy toward the animals. Because empathy toward the natural world has been found to positively relate to compassion and helping behaviors (Tam 2013b), participants' levels of empathy should be explored and compared to attitudes and engagement toward conservation. Similarly, participants could anthropomorphize the animals, as it is largely been done by the managers of the program, when giving a surname to the animal for instance. Anthropomorphism enhances sense of connection and protectiveness toward the natural world (Tam, Lee, and Chao 2013), which is why anthropomorphism should be explored in tandem with empathy when assessing the impact of such program. Overall, participation in animal adoption programs has been so far largely underexplored, whereas there is much to be done.

Finally, we strongly advise managers and educators of the two Parisian zoos (i.e. Menagerie and Paris Zoological Park), to highlight their *being away* component, to enhance or reinforce visitors' sense of disconnection from the deeply urban environment that is Paris, and thus restorativeness in zoos (Pals et al. 2009). By belonging to the French National Museum of Natural History, the three surveyed zoos benefit from a large panel of researchers, particularly in ecology and biodiversity conservation: they should therefore use more strongly these resources, to conduct research and build effective educational strategies on urban biodiversity.

Then, at a broader level, zoo designers should take into consideration soundscape in designing a zoo, because our results suggested that soundscape participated in the visitors' immersion. Moreover, further zoo-focused research should explore similar aspects as in this project in zoos where visitors are immersed with the animals, without physical barriers (e.g. Vallée des singes, in France, displays primates mostly in open enclosures in which the visitor

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can enter), to explore the impact of the close contact with the animal. Similarly, research should be conducted in zoos where only local species are displayed (e.g. Parc de Sainte-Croix, in France, only displays European species), for comparison. It remains to be seen whether people visit a particular zoo because of its proximity, or if they would be willing to spend more time and money in transportation to visit specific zoos that are farther. It would also be relevant to properly evaluate the sensory component of the zoo visit, including the olfactory sense for instance. Finally, attention should be given to the integration of samples of children in surveys in zoos, given the importance of the zoo visit in the childhood. For instance, a research project could be implemented in collaboration between a school and a zoo, to monitor changes in children's attitude, knowledge, behaviors and connectedness to nature during repeated zoo visits (every year for instance).

The perception of zoos may largely differ between naturalists, ecologists and lay people, but obviously also across cultures. Indeed, zoo attendance largely varies across world regions and countries, with more people visiting zoos in Japan and the United States (Davey 2007). In France, although zoos are quite popular among lay people, the majority of the community of naturalists has strong negative beliefs toward zoos. When I personally interacted with different people about the project, some colleagues working on ecology topics did not seem to perceive the relevance of such project, whereas laypeople were very positive about it. Therefore, although cross-cultural surveys have been conducted in zoos (e.g. Moss, Jensen, and Gusset 2015), little research has, to our knowledge, explored the cultural differences in zoo beliefs among visitors, and the differences between different publics, e.g. naturalists, ecologists, laypeople. Such exploration could be useful by clarifying the reason why zoos are almost not considered by ecologists or naturalists, and perhaps provide tools for increasing ecological studies in zoos.

Moreover, from landscape management and conservation perspectives, since we found that the exoticism in zoos could enhance people's attention to urban biodiversity, we strongly advise landscape managers to consider the potential of recreational places like zoos for providing experiences of nature and for raising people's awareness and care for the urban biodiversity. Indeed, zoos seem to be used and perceived as natural by a significant number

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of people. In addition, zoos can be found in most large cities in the world, and millions of people visit zoos every year. Zoos can therefore address messages to a large audience, potentially including people that are not fully engaged in conservation but who are aware of it (consciously or not): the zoo could therefore, through these messages, topple those persons in a more conservationist practice and attitude.

Further research should also explore the species richness and abundance of urban biodiversity in zoos. Indeed fragmented landscapes that result from the growing urbanization represent a challenge for migratory and resident species, because of the decreased connectivity among fragments. There have thus been various attempts to restore connectivity among fragments, for instance with the so-called “green and blue belt” in France (Trame verte et bleue 2016), which aims to provide a network of ecological terrestrial and marine continuities. Such ecological continuities include biodiversity reservoirs as well as ecological corridors that are crucial for enhancing biodiversity in green spaces (Vergnes, Kerbiriou, and Clergeau 2013). Much research has thus focused on greening roofs (Lundholm and Richardson 2010) and façades (Madre et al. 2015), whereas, to our knowledge, zoos have never been considered for such studies, although an urban biodiversity is actually present in zoos. Further research should therefore investigate the potential of zoos as both biodiversity reservoirs and ecological corridors, by exploring biodiversity richness and abundance within the zoos, and species movements in the zoo surroundings.

Conclusion

Conclusion

Conclusion

Because experiences of nature have changed in the last decades, and are not simply disappearing, it is important to reconnect people with nature, by increasing both opportunities and willingness to go to nature without trying to restore the previous experiences of nature that existed decades ago. It therefore requires to promote new experiences of nature (NEoN, see manuscript 6, in appendix), by giving people and social groups the opportunity to experience nature in its diversity and its dynamical complexity, and educating people about nature and about ways to experience nature. I therefore explored the potential of zoos in providing such new experiences of nature, notably because the zoo visit provides social experiences and conservation education to a large audience.

This PhD thesis thus showed that although both a single and multiple zoo visits could not be causally linked to self-reported connectedness to nature, the zoo seemed to be considered as a natural place, by people surveyed both at the zoo and outside of zoos. In addition, we highlighted the restorative component of the zoo visit, mostly through a sense of *being away* from daily urban routine. The oasis of nature the zoo provides within an urban context seemed to allow visitors escape from their everyday lives. Thus, although the experience of zoo visit did not appear to affect sense of connection to the natural world, it nevertheless somehow constitutes an experience of nature for urban dwellers. Moreover, the exoticism displayed in the zoo appeared to mediate everyday experiences of nature, facilitating visitors' perception of common biodiversity. Zoos have thus an important role to play for reconnecting people to nearby nature, even if they mostly emphasize exotic species. Although zoos seemed to be dedicated to children, with an important component of transmission of experience, they have implications for both adults and children. Indeed, they can contribute to the environmental identity construct of the children, but they can also provide adults experiences of nature, either social or individual, and increase their overall knowledge and orientations toward the natural world.

With the on-going biodiversity crisis, it is also essential to reconnect people with conservation issues. Zoos can play an important role in educating people to conservation, but their real impact on conservation attitudes and behaviors remained uncertain. We showed in this PhD project that a single zoo visit is not sufficient to increase conservation attitudes, but the repetition of such experiences could be beneficial for raising concern for

Conclusion

biodiversity. Moreover, in comparison with an urban park visit experience, the zoo visit could be a primer toward conservation attitudes, through sense of connection to nature. Zoo visits could therefore have beneficial effects on conservation attitudes, depending on people's sense of connection to nature and expectations toward the zoo visit. However, unlike conservation attitudes, our results from the survey on animal adopters suggested that the zoo, through conservation programs, might not be sufficient in promoting conservation behaviors related to threatened animals.

Therefore, it remains unsure whether zoo visits could affect connectedness to nature, and although zoos could enhance the perception of human-nature separation, the zoo visit nevertheless appeared to constitute an experience of nature that could be beneficial for urban dwellers on multiple aspects regarding benefits both for the individual (e.g. restorativeness and social cohesion) and conservation issues (e.g. conservation social identity, reconnection to local wildlife, conservation knowledge and conservation attitudes in general). To conclude, this PhD project highlighted that in the process of reconnecting people to nature and conservation issues, zoos undoubtedly provide one type of experience of nature to urban dwellers, that should be considered along with other types of experiences of nature, e.g. woodlands, especially because zoos are institutions that target a very large and diverse part of the population, worldwide.

Publications & Communications

Publications & communications

Publications & communications

Submitted manuscripts

Agathe COLLEONY, Anne-Caroline PREVOT, Michel SAINT JALME & Susan CLAYTON (Submitted to *Landscape and Urban Planning*) What kind of landscape management can counteract the extinction of experience?

Agathe COLLEONY, Léo MARTIN, Nicolas MISDARIIS, Susan CLAYTON, Michel SAINT JALME & Anne-Caroline PREVOT (Submitted to *Landscape and Urban Planning*) An anthropological exploration of soundscape in zoos: exoticism as a mediator of everyday experiences of nature

Agathe COLLEONY, Susan CLAYTON, Denis COUVET, Michel SAINT JALME & Anne-Caroline PREVOT (Submitted to *Biological Conservation*) Human preferences for species conservation: Animal charisma trumps endangered status

Manuscripts in the process of submission

Agathe COLLEONY, Susan CLAYTON, Michel SAINT JALME & Anne-Caroline PREVOT (In the process of submission to *Journal of Environmental Psychology*) Can zoo visit link nature connectedness to biodiversity concern? Comparative analysis between zoos and parks in Paris, France

Susan CLAYTON, Agathe COLLEONY, Pauline CONVERSY, Etienne MACLOUF, Léo MARTIN, Ana-Cristina TORRES, Minh-Xuan TRUONG & Anne-Caroline PREVOT (in the process of submission to *Frontiers in Ecology and the Environment*) Transformation of experience: Toward a new relationship with nature

Manuscripts in preparation

Agathe COLLEONY, Anne-Caroline PREVOT, Michel SAINT JALME & Susan CLAYTON (in preparation) What does “nature” mean at the zoo?

Publications in non-peer-reviewed journals

Prévot A.-C. & Colléony A. (2015) Une nouvelle expérience de la nature. *Pour la Science*. Dossier n°89 Climat, relever le défi du réchauffement : 102-107.

Publications & communications

Colléony A. (2015) Une expérience émotionnelle et sociale. *Travaux Dirigés pour la Classe*. N° 1094 spécial Le Parc Zoologique de Paris: 18-19.

Oral communications

Colléony A., Prévot A.-C., Saint Jalme M. & Clayton S. Defining the experience of nature of a large sample of French respondents. Young Natural History scientists Meeting (YNHM). Paris, France. 02-06/02/2016

Colléony A., Prévot A.-C., Saint Jalme M. & Clayton S. Qu'est-ce que l'expérience de visite au zoo, et quelles en sont les conséquences sur la connexion à la nature et les préoccupations vis-à-vis de la biodiversité ? Comité Français pour la Pédagogie Zoologique (CFPZ). Paris, France. 19-22/01/2016

Colléony A., Clayton S., Saint-Jalme M. & Prévot A.-C. What is a "natural place"? Perceptions of a large sample of French respondents. 27th International Congress for Conservation Biology (ICCB) and 4th European Congress for Conservation Biology (ECCB). Montpellier, France. 02-06/08/2015 (POSTER)

Colléony A., Prévot A.-C., Saint-Jalme M. & Clayton S. La visite au zoo peut-elle influencer la connexion à la nature et les préoccupations vis-à-vis de la biodiversité ? 5^{ème} Colloque Association pour la Recherche en Psychologie Environnementale (ARPEnv) : Transition écologique : de la perception à l'action. Nanterre, France. 11-12/06/2015

Colléony A., Prévot A.-C., Clayton S. & Saint Jalme M. Conservation and the "extinction of experience" : do zoos matter? 22nd Biennial Conference of International Zoo Educators Association. Hong Kong, China. 01-07/09/2014

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Colléony A., Prévot A.-C., Clayton S. & Saint Jalme M. Do Zoo experiences impact people's conservation behavior through enhanced connectedness with nature ? 8th International Zoo and Aquarium Marketing Conference (WAZA). Bristol, UK. 11-14/04/14

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Appendices

Appendix 1 :**Manuscript submitted to *Conservation letters*****Transformation of experience: Toward a new relationship with nature**

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Appendices

Abstract

Despite decades of awareness, the current biodiversity crisis remains very difficult to address. Besides preservation and restoration strategies, one approach has focused on rethinking the opportunities for people to experience nature in order to increase concern about biodiversity issues. In this essay, we suggest the need to complicate our understanding of experiences of nature (EoN). An expanded range of EoN, including negative EoN, could help people reconnect with the complexity and dynamics of biodiversity. We emphasize that EoN are embedded in social and cultural contexts, and describe how transformative, or new EoN, are emerging in combination with new social structures. Acknowledging and accepting a diversity of EoN could help address the biodiversity crisis. This supposes radical political and societal choices, as well as strong future negotiations on landscape planning and governance, but the urgency of the problem leaves no choice.

“In a nutshell” (Review and Concepts and Questions articles only)

- Individual experiences of nature (EoN), including negative ones, are varied, evolving, and embedded in a social and cultural context
- In their diversity, EoN that could help conservation should integrate the complexity and evolutionary dynamics of biodiversity
- Social and political choices could provide more opportunities to develop new and unmanaged experiences of nature, which accept ethical boundaries
- Complementary education programs could acknowledge the diversity of nature experience
- These profound social changes, which must accept unpredictable outcomes, are one innovative direction to address threats to biodiversity

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Introduction

The phenomenon of a decreasing human experience of nature, described over 20 years ago by Robert Pyle (1993/2011), has generated a growing amount of research, recently reviewed and summarized by Soga and Gaston (2016). According to this formulation, societies that follow a Western way of life face a progressive disaffection toward nature, from both a loss of opportunities and a reduced orientation, or willingness, to encounter nature. The so-called “extinction of experience” is presented as having deleterious consequences for human well-being and health, as well as for people’s emotional, attitudinal and behavioral relations to nature and biodiversity (Soga & Gaston 2016). This hypothesis is appealing to the conservationist community, because it suggests that attention to human needs may help to address the biodiversity crisis. Indeed, as raised in the Aichi targets of the current strategy for biodiversity (Mace et al. 2010), individual humans are part of the biodiversity issue and should be integrated in future conservation trajectories. We agree with earlier writers that direct contact between people and the natural environment has been reduced, and that the consequences of this reduction are concerning. However, previous authors have primarily defined experiences of nature in terms of individual contacts with nature, and in general suggested that the remedy for both humans and ecosystems lies in facilitating more opportunities for such contacts. In this essay, we advocate a reexamination of the complex human relationship with nature and the ways in which it is constructed by society, in order to discuss how experiences of nature could effectively address the biodiversity crisis.

The formal definition of the term “experience,” refers to the “process of getting knowledge or skills from doing, seeing or feeling things”, or to “something that happens to you that affects how you feel” (<http://dictionary.cambridge.org/dictionary/english/experience>). Thus it is importantly different from mere “contact” with nature, a term that is also often used in the literature. Experience should change people, in ways that can ultimately be integrated into individual identity (e.g., Clayton, 2012). The term “nature”, meanwhile, encompasses a wide range of forms in the research literature as well as a diversity of cultural conceptions (Kluckhohn & Strodtbeck, 1961). In the context of the biodiversity crisis, we argue for a definition of “nature” that incorporates the degree of human control over the dynamic and evolutionary potential of non-human species and ecosystems (Ridder 2007; see Figure 1), factors that are crucial components of biodiversity for conservation practitioners and scholars (Soulé 1985).

In this paper, we describe the experiences of nature (EoN In the following) as more diverse and complex than previously acknowledged, and as embedded in social and political contexts. Thus, EoN must be seen as a process, including 1) interactions between individuals and natural entities; 2) social and cultural context; and 3) outcomes for new skills, knowledge, or behavioral changes. The relational or social context for the experience has been neglected (cf. Chan et al., 2016). We argue that, rather than just being extinguished, it is more accurate to describe EoN as being transformed along with a changing society. Finally, we propose some perspectives on how renewed EoN could help conserve biodiversity, in a systemic approach encompassing societal changes.

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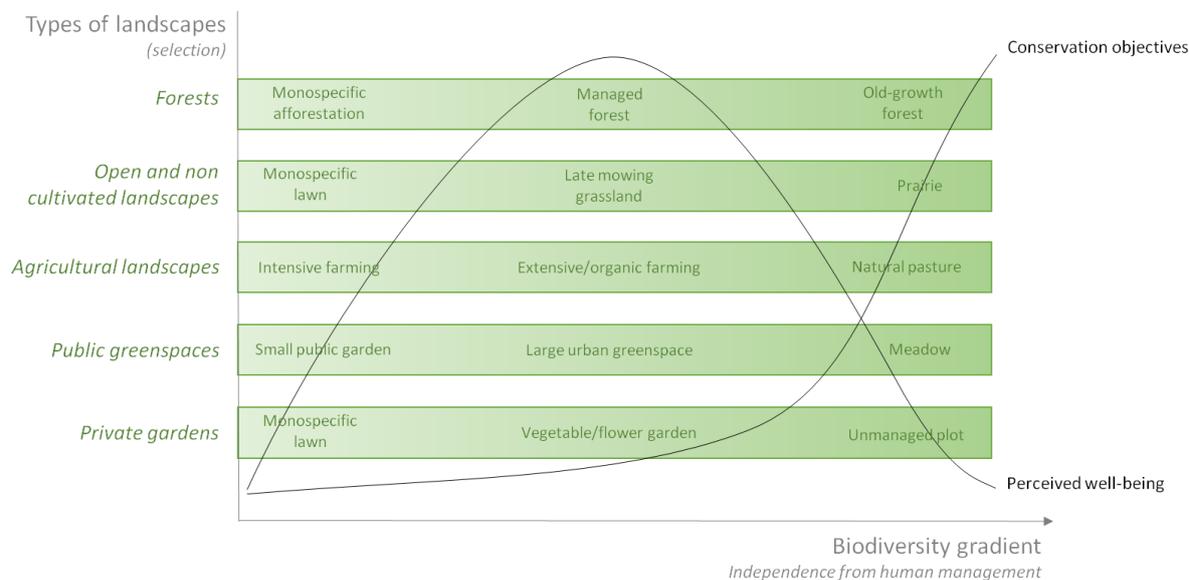


Figure 1: Different types of nature may promote different objectives

Describing the EoN

Experiences of nature can be described according to the nature that is present (the naturalness, diversity and dynamic of the landscape), as well as by its extent in time and space. Like all human experiences, they are based on sensory input; nature experiences are particularly rich in their ability to engage multiple senses, and people may attend to smells and tactile sensations to a greater extent in natural than in human-built contexts (e.g., Kaplan & Kaplan 1989). However, each experience also develops over time as a process in which the experience is interpreted and reinterpreted in coordination with other aspects of a person's life. Because human perceptions are based not only in objective reality but also in interpretation, the ways in which people describe their experience will not correspond perfectly to the objective reality of the experienced landscape. The impact of an experience is mediated by the perceptions of that experience as well as its compatibility with the perceiver's goals (Kaplan & Kaplan 1989).

Thus, the experience also can be described according to its immediate social context, shaped by the larger society and culture. For many people, an important part of their EoN comprises the other people with whom they share the encounter, but even a solitary experience is constituted by the social meanings of the event and its social precursors and consequences. Social meanings of "nature" will shape the experience, so that particular landscapes (e.g. zoos, parks, gardens: Colding et al. 2006) may or may not be defined as nature by their visitors. Social precursors include economic and demographic indicators that make access to nature easier or more difficult and that may suggest that people "belong" or "do not belong" in natural settings (Buijs et al. 2009, Wolch et al. 2014). Social consequences may include self-identification or identification by others as, for example, an "environmentalist"; an identification which may be welcomed or rejected (Zavestoski 2003).

With these perceptual and social aspects in mind, we propose an initial list of some dimensions of EoN that deserve attention (Table 1). These represent continuous, not dichotomous dimensions, so

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that experiences may fall at varying points between the two endpoints defined by the table. We recognize that the list is incomplete, and that some of these dimensions may be further subdivided; for the sake of simplicity, however, we take this table as a starting point.

Table 1 : Dimensions of nature experiences

Dimension	Description - Examples
Active vs. passive	Is the participant an observer, as in someone who watches a bird on the seaside? Or is the participant behaviorally engaged by feeding the bird?
Consumptive vs. appreciative	What is the relationship of the participant to nature? Is it to exploit environmental resources, e.g. by hunting, or to simply appreciate them, e.g. by bird-watching?
Intentional vs. unintentional	Did the participant seek out the experience, for example by visiting an urban park to see nature, or is it an unintended correlate of experience, for example someone who visits the same park in order to exercise?
Separate vs. integrated	Does the participant have to depart from his or her regular routine to make a special effort to experience nature, or is the encounter integrated within his or her daily life?
Solitary vs. shared	Is the participant alone, or with others who are sharing the experience?
Positive vs. negative	Is the emotional response to the experience positive or negative?

These dimensions have significant implications for how people will respond to an experience through changes in cognition, motivation, and behavior. Active experiences are likely to be more vivid and multisensory, and thus more memorable. Consumptive experiences may evoke different values than appreciative experiences (but see Cooper, Larson, Dayer, Stedman, & Decker, 2015), and are more likely to have negative impacts on the conservation of nature. Intentional experiences may give people a greater sense of autonomy and control, but also raise the question of whose intentions are guiding the encounter; in environmental education, this highlights the distinction between formal educational settings in which the educator is deliberately constructing an experience, and free-choice learning, in which the experience is more self-directed (Falk, Heimlich, & Foutz, 2009). Integrated experiences will probably have greater impact on habits and routines than those that are separate; in environmental education, again, some of the features associated with greater impact are a longer duration over time and an integration between in-class education and experiences in natural settings (Sauvé et al. 2001). We note, however, that separated experiences, by virtue of their very distinctiveness, may have a profound impact in leading people to a different perspective, as suggested by research on transcendent experiences (Vining & Merrick 2012). For many people

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“connecting to nature” is significantly motivated by the desire to “disconnect” or escape from the modern urban environment (Kaplan & Kaplan 1989), and is interpreted by the contrast between the two contexts. Social experiences convey social support and social norms, with the resulting potential for long-term impacts on people’s attitudes and behavioral inclinations.

We want to particularly highlight the positive vs. negative dimension of experience. Although many previous authors have emphasized only the positive emotional response to nature, it is essential to also consider negative aspects of EoN. Indeed, nature can prompt fear, disgust, and anxiety (Bixler & Floyd 1997; Kellert 2014). This potential for insecurity and vulnerability has implications for individuals and for biodiversity. Besides individual challenges and tests of competence and skills, negative EoN can motivate an appropriate restraint on human interference with nature. People might be more willing to interfere with nature if it did not have the capacity to induce fear (Kellert 2014). In that way, negative EoN are not antithetical to conservation purposes; being afraid in nature can co-exist with a sense of care, as shown by Kahn et al. (2008) among children visiting bats in a zoo. Moreover, unpleasant experiences and disliked species may make people more aware of the complexity and unpredictability of biodiversity. More than subjectively-perceived “good” and “bad” species, biodiversity is made of interrelated components. Experiencing a “bad” interaction with nature, such as a mosquito bite or a natural disaster, can therefore teach us that biodiversity is not designed to satisfy human interests and does not conform to an idealized view of nature.

Nature experiences that encompass multiple locations along the dimensions in Table 1 may thus help to develop an appropriate appreciation of the natural world. At the personal level, the extent of nature experience during childhood strongly determines the extent to which a person will develop a sense of themselves as being a part of the natural world (Chawla 1988), or environmental identity, which in turn will increase environmental concern and pro-environmental behavior (Clayton 2012). Individuals with greater experience of nature tend to demonstrate less fear for wild environments (Bixler & Floyd 1997; Roskaft et al. 2003). At the social level, nature experiences are valued for promoting social bonds and shared value; even negative experiences of nature, when shared, can facilitate social interactions. Moreover, social experiences of nature, like community gardens, by offering learning opportunities, can encourage and reinforce certain forms of engagement toward nature and conservation (Krasny and Tidball 2012). Indeed, being part of a social group engaged toward a common issue, such as biodiversity conservation, can promote self-efficacy and social empowerment – important predictors of sustainable behavior – as well as social bonds. Thus, experiences of nature can be beneficial for ecosystems, both at the individual and the community levels, creating individuals and communities with shared values, experiences, and knowledge about the natural world.

Figure 2 describes the EoN as a process in which individual, social, and natural factors precede the complex experience, which in turn has outcomes that can be seen at the level of person, social context, and environmental conservation. Notably, in a reciprocal process, the outcomes in turn feed back to change existing nature, society, and individual characteristics. It is these changes that we examine next.

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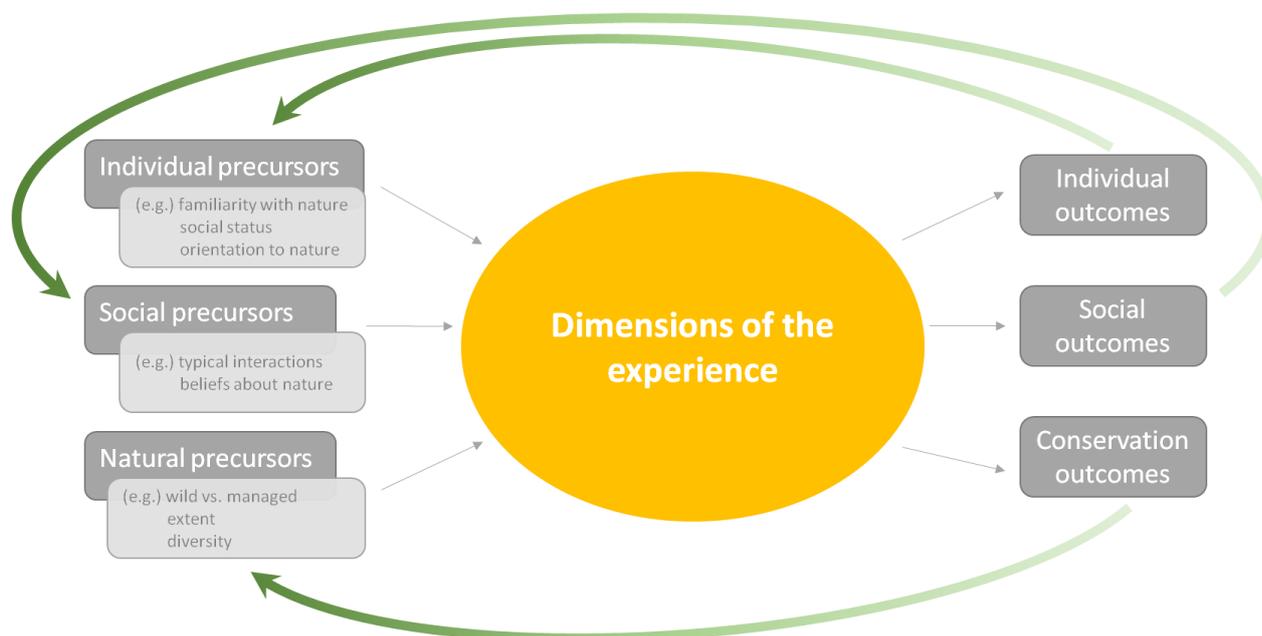


Figure 2: The experience of nature as a process

Changing experiences of nature

Many people, including parents, have become concerned by the extinction of EoN (as popularized by Louv 2008), and try to replicate their own EoN for their children (see <http://www.childrenandnature.org>). Similarly, calls by conservation scientists and practitioners to reconnect people with nature suggest a belief that engaging in the same activities (such as playing outside) would lead to the same outcomes for attitudes, emotions, and behaviors toward nature that were achieved in the past. However, global urbanization and the development of technology, in combination with new ways of working, seeing the world, and consuming, are too different today to allow the experience of earlier generations to be reproduced. Viewed within a social context that has experienced profound changes, the extinction of traditional EoN must be seen as an effect of modernity. Most humans do not need to interact with nature for biological reasons anymore; in parallel they have lost the associated skills and knowledge (e.g. traditional ecological knowledge, or TEK) and developed new perceptions of nature and its place in human lives (e.g. Pilgrim et al. 2008).

These societal changes have transformed the ways in which we collectively experience nature. Novel technology-based interactions allow us to “mediate, augment or simulate the natural world” in order to have symbolic or vicarious experiences of nature (Kellert 2014). Nature-based reality shows, documentaries, and streaming animal cameras create an experience of nature for many modern citizens while they are sitting in their homes; video games even allow people to virtually interact with nature. People can live in isolated, remote places near wild nature while still actively participating in modern life through an internet connection. In western countries, some conventional farmers are able to collect a large amount of data about their farm, using sensors to control their engines remotely and automate almost all their activity without the need to go outside. We do not yet have evidence about the impacts of these experiences integrating nature and technology, but they will

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continue to characterize the new EoN (or NeoN). Rather than dismissing these forms as inauthentic, we should examine the ways in which they help to construct people's attitudes and behaviors toward nature.

In parallel with these changing interactions, there is a change in the social construction of nature. Whereas in the past nature was encountered as a fundamental part of daily life, intimate and individual, it is now sought out as a managed "experience" that is planned and often shared with others (for example, through touristic or educational experiences and subsequent Facebook posts or Instagram uploads). In this way, EoN can be conceived as a service to be produced for the maintenance and development of society. Such EoN must be seen as shared, controlled and planned, that is to say defined and used for specific predictable effects such as individual wellbeing, satisfaction, "escape," and as a method for educating citizens to have the "correct" concerns about nature. With these specific services in mind, EoN can also be easily rejected for having not met the preconceived criteria. As Chan et al. (2016) stated, "as a means (instrument) to something else, [nature] is potentially replaceable" (p. 1463).

The idea of nature as a service, intended to increase individual wellbeing and/or pleasure, raises the question of a market within which such services are procured and advertised. An emphasis on positive outcomes of EoN may encourage preference for an idealized and controlled nature rather than one that is both ecologically and culturally diverse. However, although some types of EoN may be better than others at achieving particular outcomes, the evidence base for describing a "best" experience is still thin. More importantly, not all outcomes are equivalent and perhaps have not all have even been described (Chan et al. 2016). Nature that is managed for human wellbeing is not necessarily nature that is best at promoting healthy ecosystems or other values. We advocate an alternative approach that avoids a single-minded focus on managing nature for particular outcomes, no matter how worthwhile those outcomes may be, and instead adopts a willingness to allow different, locally-relevant forms of human-nature interactions, (as long as they show respect and value for biodiversity, conforming to Aldo Leopold's (1949/1986) land ethic).

Figure 3 illustrates a conceptual progression from the typical view of EoN to a new understanding. The traditional view emphasizes individual relationships with nature, but for the most part the role of society in framing and enabling those relationships is invisible. In the new perspective, a recognition of the complexity of the EoN leads us toward a model in which society, nature, and individual are interconnected. This new model suggests two main recommendations for practice: (1) enabling diversity of experiences rather than striving for an idealized relationship, and (2) educating people about how to experience nature rather than how to consume nature experience.

Conclusion

The biodiversity crisis has been recognized for over 30 years, but we have not yet effectively addressed the problem (Mace et al. 2010). The urgency of this crisis requires radical societal innovations. Weick (2009) describes a dynamic process of "sensemaking," in which social changes correspond to new representations and rules associated with new social behaviors, with a reciprocal relationship between action and knowledge. According to this definition, new EoN at the collective

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level can thus be seen as a social change generator: creating new representations, knowledge and skills associated with new social arrangements and practices.

This paper has emphasized the diversity of new EoN. In a complementary way, we encourage consideration of ways in which EoN are linked to the diversity of local environments and cultures, with the potential to affect conservation. A variety of social initiatives have already been developed that encourage the conservation of biodiversity, individual empowerment and social-ecological resilience, such as green architecture, urban community gardens, and adaptive co-management. Integrating existing experiences of nature into these practices could further help the resilience of social-ecological systems. However, these local initiatives must inform efforts to address the urgency of the crisis at a global level. Just as community-based conservation should recognize the complexity of the ways in which local communities experience nature, and value local knowledge, our global efforts to protect nature need to consider the cultural diversity of ways in which people understand and experience nature (Kothari, Camill, & Brown, 2013).

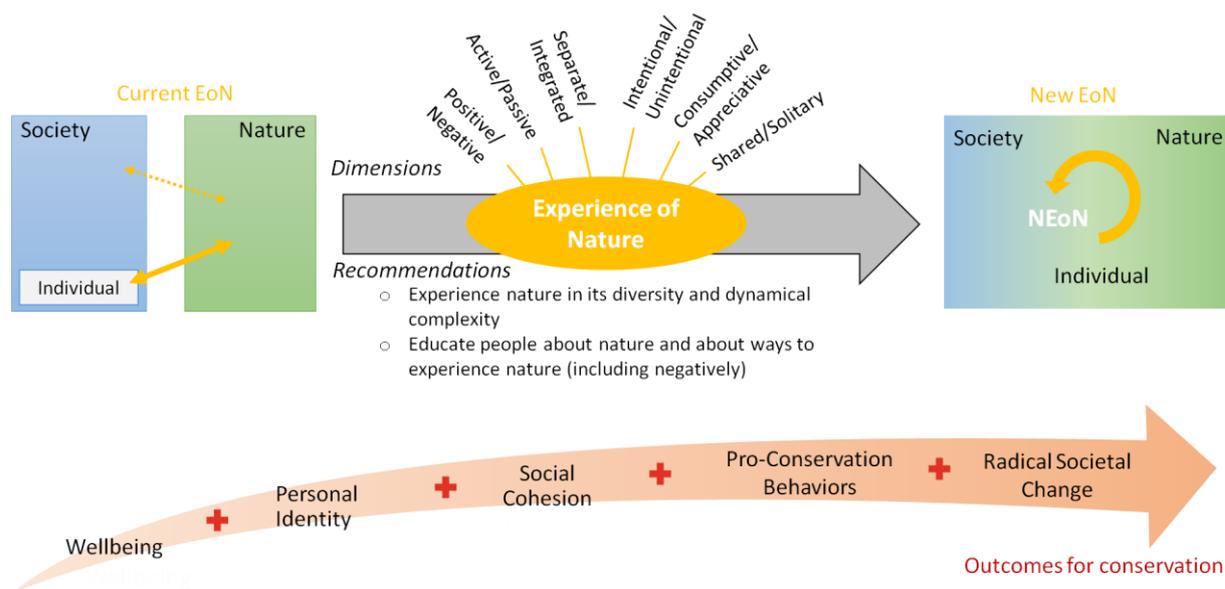


Figure 3: Toward a new paradigm for Experiences of Nature

Creating the conditions to encourage socially shared experiences of nature requires political choices. First, we need to create opportunities for people and social groups to experience nature in its diversity and its dynamical complexity. Rather than developing techniques that aim to standardize a particular idea or experience of nature, we should accept a lack of control over the outcome of these experiences. Second, we need to re-think the goals of environmental education: not only to educate people about nature, but also and mostly to educate them about ways to experience nature, in its complexity and unpredictable dynamics. Experiencing nature, including negatively, will help represent nature in a way that is not idealized and disconnected from human lives, but as something humans are part of.

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These changes will lead to unpredictable consequences, perhaps even creating further challenges to biodiversity conservation. But such changes may be necessary to address the biodiversity and environmental crises.

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Appendices

Appendix 2 :

Book chapter “Le zoo, un lien de reconnexion à la nature ”

In « Expériences de nature », edited by Anne-Caroline Prévot and Cynthia Fleury at CNRS editions.

Le concept de zoo ne date pas d’hier, puisque la création du premier zoo ouvert au public date du XVIII^e siècle : la Ménagerie du Jardin des Plantes à Paris et le zoo de Schönbrunn (Vienne) sont les deux plus vieux zoos du monde (Baratay et Hardouin-Fugier 1998), même si des collections privées réservées à l’Aristocratie existaient bien avant cela. Les animaux composant les collections sont à l’époque bien souvent des cadeaux diplomatiques. Les zoos mettent alors en scène une domination des humains sur les animaux sauvages et, par ce biais une domination plus générale sur la nature (Baratay et Hardouin-Fugier 1998). Au départ réservés aux classes sociales supérieures, les zoos se popularisent rapidement (Derex 2012) : les visiteurs se succèdent pour aller observer ces animaux sauvages, exhibés à cette époque dans des cages ou des enclos sommaires grillagés et bétonnés. Les années passant, la vision sociétale de la nature et de la condition animale évolue, la place des humains est de plus en plus considérée comme dans la nature et non plus en position dominante (Derex 2012). De façon similaire, les parcs zoologiques ont donc largement évolué pour ne plus présenter uniquement une large variété d’animaux exotiques pour satisfaire un public, mais pour devenir de véritables centres de conservation des espèces (Rabb 2004). Une directive européenne de 1999 demande d’ailleurs que les institutions zoologiques prennent des mesures de conservation incluant (1) la participation à la conservation des espèces menacées et à la recherche en conservation, (2) l’éducation et la sensibilisation du public, et (3) la mise en place de conditions de captivité satisfaisant les exigences biologiques et de conservation pour chacun des animaux captifs (Conseil de l’Union Européenne 1999). Une attention croissante se porte alors sur l’environnement naturel des animaux présentés et pousse les zoos à modifier la conformation des enclos et les végétaliser progressivement, pour répondre aux exigences de bien-être et aux conditions biologiques de l’animal. L’objectif actuel des zoos est donc double : le visiteur doit pouvoir observer les animaux sauvages dans ce qui ressemble le plus à leur environnement naturel, et l’animal doit bénéficier des meilleures conditions de captivité en termes de bien-être.

La conservation, « mission essentielle des parcs zoologiques au XXI^e siècle » (Encyclopédie universalis⁸), se traduit notamment par des programmes d’élevage d’animaux en captivité (EEP) pour le maintien d’une diversité génétique au sein des populations sauvages. Cependant, la contribution des zoos à la conservation des espèces reste encore très controversée, notamment parce que les collections animales des zoos sont majoritairement

⁸ <http://www.universalis.fr/encyclopedie/zoo/2-les-missions-d-un-parc-zoologique/> [consulté le 6 février 2016]

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composées de vertébrés de grande taille et d'espèces relativement peu menacées et peu endémiques (Balmford et al. 1995, Conde et al. 2011, Fa et al. 2014, Martin et al. 2014). La seconde mission des zoos est l'éducation du public à la conservation. De nombreux moyens très diversifiés sont utilisés pour délivrer les messages d'éducation à la conservation : panneaux informatifs, bornes interactives ou activités. Par exemple, au Parc Zoologique de Paris, des panneaux informent les visiteurs sur la biologie et les comportements des espèces présentées, et des kiosques pédagogiques composés de supports pédagogiques plus interactifs (comme des tablettes tactiles) sont répartis dans le parc. Les visiteurs sont ainsi totalement libres d'utiliser ou non ces supports informatifs. Dans ce même parc, des médiateurs scientifiques expliquent plus en détail la biologie, le statut de menace ou le comportement de certains animaux présentés, la girafe par exemple. Les visiteurs peuvent assister librement à ces présentations, voire interagir avec le médiateur. Pour les plus motivés, des visites guidées payantes sur différents thèmes sont proposées sur réservation (Parc Zoologique de Paris 2016). Les visiteurs bénéficient ainsi d'un large panel de dispositifs éducatifs tout au long de leur visite. Cependant, d'une façon générale, très peu de visiteurs prennent le temps de lire les panneaux informatifs, et pour ceux qui le font, il s'agit bien souvent d'une lecture très brève. En effet, une étude dans un zoo américain (Clayton et al. 2009) a pu montrer que seulement 27% des visiteurs observés de ce zoo prêtent attention aux panneaux informatifs ; les auteurs ont suggéré que l'attention portée aux panneaux informatifs dépend de la capacité de l'animal à éveiller la curiosité du visiteur, mais aussi de la localisation et du design du panneau par rapport à la zone d'observation de l'animal. Il semblerait malgré tout que les visiteurs (adultes comme enfants) quittent le zoo avec plus de connaissances sur la biodiversité qu'à leur entrée (Jensen 2014, Moss et al. 2015), même si ces résultats ne sont pas toujours consensuels.

Dans ce chapitre, j'explore comment les parcs zoologiques pourraient contribuer à la conservation de la biodiversité de manière détournée, en étant des lieux possibles de reconexion à la nature, notamment pour un public urbain considéré comme vivant une extinction de l'expérience de nature (Pyle 1978 ; Prévot et Fleury cet ouvrage). Cette hypothèse repose sur le fait que, si la nature (animaux et paysages) présentée dans les zoos est très artificielle, les visiteurs entrent en relation avec celle-ci, par l'émotion, l'attachement et le partage de leurs expériences avec les autres. La nature présente dans les zoos, qu'elle soit exotique ou locale, pourrait permettre une immersion des visiteurs dans « autre chose » que leur quotidien. Cette déconnexion pourrait être le départ vers une connexion à autre chose. J'appuie cette réflexion sur les travaux que j'ai menés lors de ma thèse dans les trois zoos du Muséum national d'histoire naturelle, le Parc zoologique de Paris (dit « zoo de Vincennes »), la Ménagerie du jardin des plantes et la réserve de la Haute-Touche, dans l'Indre.

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Les zoos semblent être plus des espaces de loisirs que des espaces de nature

Les changements historiques de perspectives et d'objectifs des zoos se sont accompagnés de modification des paysages de ces espaces, vers plus de végétalisation. C'est le cas par exemple de la Ménagerie du Jardin des Plantes à Paris, qui présentait de nombreuses espèces dans un environnement très bétonné, et qui maintenant se compose de largement moins d'espèces, dans de plus grand enclos très végétalisés. Cependant, cette végétation reste totalement maîtrisée, mise en décor et gérée. C'est aussi le cas des collections animales présentées, pour lesquelles l'accent est souvent mis sur les espèces exotiques, rares ou charismatiques pour attirer les visiteurs, au détriment d'espèces locales ou moins connues, même si elles sont parfois plus menacées (Conde et al. 2011, Frynta et al. 2013). En effet, les espèces charismatiques sont bien souvent utilisées pour tenter de sensibiliser les populations à la conservation de la biodiversité (Skibins et al. 2013, Fa et al. 2014), et les espèces d'animaux exotiques sont parfois plus connues que les espèces animales locales (études auprès d'enfants en France: Ballouard et al. 2011). D'ailleurs, dans les zoos, il semble que les visiteurs restent plus longtemps à observer les mammifères et espèces charismatiques que les autres taxons et espèces moins charismatiques (Moss et Esson 2010). De même, les visiteurs des zoos sont plus attirés par des espèces dites « rares » en comparaison à des espèces plus communes (Angulo et al. 2009).

Enfin, les zoos sont des espaces très fréquentés (un million de visiteurs au ZooParc de Beauval en 2012 et plus d'un million au Parc Zoologique de Paris en 2014 ; Les Zoos dans le Monde 2015, ZooParc de Beauval 2016) : au Parc zoologique de Paris lors des fortes affluences, certains visiteurs disent retrouver l'ambiance d'un espace public comme un parc d'attraction. Quand ils sont interrogés sur les raisons de leur visite au zoo, les visiteurs mentionnent majoritairement le côté récréatif, en expliquant qu'ils viennent passer un moment en famille ou entre amis (Reade et Waran 1996). D'ailleurs, le côté récréatif de la visite est largement mis en avant sur les sites internet des zoos, même si les mots « divertissement » ou « récréatif » restent peu ou non utilisés directement (Carr et Cohen 2011). Dans les trois zoos du Muséum, le public est très diversifié, toutes les catégories socioprofessionnelles sont représentées : sur un échantillon de 446 visiteurs, 27.80% étaient des employés, 27.13% des cadres, 18.16% des retraités, 8.07% étaient sans activité professionnelle (étudiants inclus), 7.62% des artisans, et dans une moindre mesure, 4.71% des personnes issues de professions intermédiaires, 3.36% des ouvriers et 0.67% des agriculteurs.

Les zoos ne sont donc pas des espaces de nature sauvage, autonome et vierge de toute présence humaine.

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Les animaux et les zoos sont sources d'émotions

Si le but premier de la visite au zoo est le divertissement, les visiteurs choisissent de se rendre au zoo pour voir des animaux « en vrai » (Rabb 2004). L'animal est l'élément central du zoo : il suscite de l'intérêt, qui peut alors favoriser le désir d'en apprendre davantage sur l'espèce, puis une prise de conscience de la nécessité de préserver l'environnement ; il symbolise un ailleurs, d'autant plus important qu'il est exotique et charismatique; enfin, il encourage l'expression d'émotions.

Une enquête auprès de 84 personnes quittant la Ménagerie du Jardin des Plantes pendant le printemps 2013 a montré que les visiteurs avaient éprouvé des niveaux plus élevés d'émotions positives (intérêt, plaisir, fascination, joie et fierté) que d'émotions négatives (tristesse, anxiété, honte, peur et colère) devant les animaux. Une étude auprès de personnes ayant parrainé un animal du Parc Zoologique de Paris confirme l'existence d'émotions devant les animaux : en moyenne, les parrains ont ressenti plus d'émotions positives que d'émotions négatives envers les animaux qu'ils ont parrainé (scores moyens de 3.9 et 1.4 respectivement, sur une échelle de *1-peu ressenti* à *5-fortement ressenti*). Les émotions ressenties envers les animaux pourraient être pour certains visiteurs des moyens d'entrer en empathie avec eux, même si le dispositif du zoo ne favorise pas forcément cette attitude : Véronique Servais (2012) explique en effet que les environnements très appauvris du zoo et l'absence d'une bonne connaissance de l'histoire naturelle de l'espèce rendraient difficile la perception des liens entre le comportement et le milieu qui l'a façonné ou auquel il se rapporte, alors que c'est cette perception qui justement favorise l'empathie. Plus précisément, certaines personnes s'identifient plus ou moins facilement aux animaux. C'est particulièrement vrai avec les primates, du fait de leur fortes similarités avec les humains (Servais 2012).

Les émotions ressenties devant les animaux sont souvent partagées avec les personnes présentes dans le zoo, que ce soit des proches ou les autres visiteurs. Susan Clayton et ses collègues ont observé en effet que la majorité des paroles des visiteurs devant un enclos visent à faire partager avec les membres du groupe son ressenti vis-à-vis de l'animal présenté (Clayton et al. 2009). Fraser et al. (2009) proposent que le partage des émotions favorise les interactions sociales et contribue au processus de cohésion de groupe chez les adolescents qu'ils ont suivis. Plus généralement, une étude récente au Parc zoologique de Paris montre que les émotions devant les animaux peuvent être partagées entre personnes qui ne se connaissent pas : quand un visiteur s'exclame car il a enfin trouvé l'animal dans son enclos ou parce qu'il a vu un comportement étonnant, un mouvement de groupe s'enclenche et l'expérience est partagée. Effectivement, les dimensions sociales et émotionnelles de la visite au zoo ont largement été démontrées (Reade and Waran 1996, Morgan et Hodgkinson 1999, Myers et al. 2004, Clayton et al. 2009, Fraser et al. 2009), notamment grâce aux expériences émotionnelles positives riches et variées que les zoos

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proposent. Or, les personnes qui ressentent des émotions positives vis-à-vis des animaux captifs sont aussi celles qui ont des préoccupations environnementales plus fortes et qui soutiennent plus les projets de conservation (Kals et al. 1999, Allen 2002, Hayward and Rothenberg 2004, Myers et al. 2004). Reconnaître la dimension émotionnelle de la visite au zoo est donc fondamental dans un objectif de conservation.

Les animaux et les zoos sont sources d'attachement

Différents types d'attachements peuvent être notés au zoo. Le premier est l'attachement à un animal en particulier, qui favorise le désir de revenir au zoo pour le voir; c'est par exemple le cas de Nénette à la Ménagerie du Jardin des Plantes, que de nombreux visiteurs connaissent et prennent plaisir à revenir voir (observation personnelle, 2014); cette femelle Orang-outan a d'ailleurs fait l'objet d'un film documentaire (Philibert 2010). Une autre forme d'attachement concerne un zoo donné, pour des personnes qui ont vécu une ou des expérience(s) particulière(s) dans ce lieu (par exemple, un souvenir de balade à dos de dromadaire dans le parc zoologique de Paris raconté par deux sexagénaires, pendant leur enfance). Enfin, certaines personnes peuvent être attachées à l'expérience de visite au zoo en général, comme celles qui ont souvent visité des zoos avec leurs parents quand elles étaient enfants et qui y retournent ensuite avec leurs propres enfants. Pour ces personnes, la visite au zoo est un élément important de leur enfance, qui a participé à la construction d'une identité qu'ils veulent partager et transmettre à leurs propres enfants.

Un cas particulier d'attachement à l'animal de zoo peut être caractérisé par le fait de le parrainer. De nombreux zoos proposent d'« adopter », de devenir le « parrain », d'un animal en particulier au zoo, pour un montant financier défini, en échange de contreparties qui varient selon le montant investi. Ce système de parrainages est la plupart du temps annoncé comme un programme permettant de financer la conservation (des animaux parrainés ou des animaux en général). Dans ces programmes, tout est souvent fait pour individualiser et parfois même anthropomorphiser l'animal, en lui donnant un prénom. Au Parc zoologique de Paris, 29 animaux sont proposés au parrainage. Une enquête auprès de 2134 parrains a récemment montré que les causes du parrainage sont nombreuses, comme aider le zoo dans sa mission de conservation, dans sa mission de recherche ou encore parce qu'ils ressentent un lien avec l'animal en question. Une forte proportion de participants sont des Parisiens, et parmi les parisiens, des habitants du 12^{ème} arrondissement où se situe le zoo ; cette observation témoigne bien de l'attachement que peuvent porter certaines personnes au zoo, ainsi qu'aux animaux qu'ils pourront ainsi venir voir plus facilement. Les parrains interrogés parlent quelquefois d'une relation privilégiée avec l'animal, qu'ils vont jusqu'à anthropomorphiser : par exemple, une femme trentenaire mentionnait qu'elle comptait « bien rencontrer Aramis [le jaguar] et ses amis très bientôt ! », ou une autre femme de soixante ans environ qui espère que son animal « a pu trouver une compagne ».

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Certaines personnes vont même au-delà, en s'appropriant l'animal adopté, en le qualifiant par exemple de « filleul » (ou par exemple « mon jaguar ») : une femme d'environ 50 ans expliquait ainsi qu' « accompagnée de [ses] petits enfants, [elle était] curieuse de voir [sa] filleule et son girafon ».

Cependant, l'étude plus approfondie du choix des animaux et du montant investi par animal dans le cadre de ce programme a montré qu'aucune attention ne semblait être portée au statut de menace de l'animal : les espèces plus menacées ne sont pas plus parrainées, et ne récoltent en moyenne pas plus d'argent que les autres espèces. A l'inverse, les participants semblent choisir largement plus les espèces plus charismatiques, comme la girafe ou le jaguar par exemple. Cependant, de manière surprenante, les espèces moins charismatiques ont récolté en moyenne plus d'argent par personne que les espèces plus charismatiques, ce qui suggère que les personnes ayant parrainé des espèces moins charismatiques seraient mieux informées des biais potentiels liés à cet attrait pour les espèces charismatiques justement, et auraient ajusté leur contribution en conséquence. Enfin, les participants semblaient aussi choisir davantage des espèces phylogénétiquement proches de l'humain. Il reste encore beaucoup à explorer dans le domaine du consentement des personnes à payer pour la conservation d'espèces, mais nos résultats soulèvent ici des questions quand à l'efficacité d'un programme explicitement dédié à la conservation des espèces sur la reconnexion des participants aux enjeux de conservation.

Les animaux et les zoos permettent une immersion dans un « ailleurs »

Comme mentionné précédemment, les animaux captifs du zoo sont plutôt des espèces exotiques et charismatiques. Dans les zoos les plus récents (comme le parc zoologique de Paris), l'environnement dans lequel ces animaux sont présentés rappelle au plus près leur environnement naturel, dans une perspective d'immersion du public dans un ailleurs (Coe 1985). Par exemple l'enclos des girafes rappelle la savane africaine, tandis que la serre tropicale évoque l'environnement de Guyane et de Madagascar, avec leur faune et leur flore luxuriante. Au-delà des espèces présentées, le paysage du zoo est donc construit pour emmener le visiteur dans un monde « naturel », en partant de l'idée que les animaux sauvages ne peuvent « intégrer le monde artificiel qui tisse la trame de notre quotidien et qu'[ils occupent] les espaces « déserts », inhabités par l'homme » (Cosson, 2007 p.84).

Or il se trouve que la visite ne permet pas toujours une rencontre solitaire avec l'animal dans son milieu naturel ; ce n'est même souvent pas ce qui est recherché par les visiteurs, qui viennent en visite en famille ou entre amis et qui naviguent au milieu de nombreux autres visiteurs. Pourtant, la visite semble quand même permettre une évasion ; comme le suggère

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une étude récente dans les deux zoos parisiens⁹. Ce travail anthropologique a cherché à caractériser les ambiances des visites ressenties par vingt volontaires, en s'attachant aux ambiances sonores. Les résultats indiquent trois types de sons dans l'ambiance du zoo : des sons anthropiques (cris d'enfants, brouhaha de la foule), des sons mécaniques (bruit de soufflerie, de travaux ou de trafic routier) et des sons de nature, émis un peu par les espèces captives mais surtout par les espèces non captives. Les animaux entendus sont très majoritairement les oiseaux (devant les primates), et bien souvent des espèces urbaines non captives comme les pigeons ou les moineaux, qui ne font pas partie de la collection du zoo. Ce résultat inattendu suggère que si les zoos présentent des espèces captives, la biodiversité ordinaire et urbaine fréquentant ces espaces participe à l'ambiance (au moins sonore) du lieu. Un animal captif qui fait un son mobilise l'attention du visiteur, qui part à la recherche de l'origine de ce son ; cet effort de concentration pourrait permettre au visiteur de faire abstraction de toute autre source de son (comme les voix humaines ou les bruits de la ville), de s'immerger dans le milieu « naturel » de l'animal recherché et de se déconnecter de son quotidien urbain. Cependant, la biodiversité non captive présente dans les zoos, dont la présence est perçue par les visiteurs, semble contribuer à installer les visiteurs dans un espace de nature plus locale. Ces résultats suggèrent donc que si le zoo permet une rencontre avec une nature dite « exotique », il place également le visiteur au cœur d'un environnement de nature plus locale et plus proche de ce qu'il expérimente (ou non) au quotidien.

Les zoos sont-ils des espaces de reconnexion ?

Les zoos offrent donc des possibilités d'expériences de nature particulières, dans une nature entièrement recréée, mais qui peut être autant exotique que locale. Pourtant, une reconnexion directe à la « nature » via le zoo reste incertaine ; d'abord car le fait de montrer des espèces en captivité pourrait à l'inverse renforcer l'idée de séparation entre les humains et la nature ; ensuite car montrer des espèces exotiques pourrait ne pas aider les citoyens à se reconnecter avec la biodiversité qui les entoure au quotidien, alors qu'il semble à l'heure actuelle nécessaire de faire prendre conscience au public de la biodiversité qui l'entoure et de l'intérêt de la préserver. D'ailleurs, les travaux qui ont étudié comment les zoos pourraient augmenter le sentiment de connexion à la nature apportent des résultats contrastés : Bruni et al. (2008) proposent que le sentiment de connexion à la nature ne change pas consciemment au cours d'une visite, mais qu'il pourrait s'opérer inconsciemment. Pour autant, une enquête auprès de 446 visiteurs des trois zoos du Muséum suggère au contraire que les visites répétées au zoo n'influencent pas le sentiment de connexion à la nature.

⁹ Travail de Léo Martin, encadré par Agathe Colléony, Nicolas Misdariis et Anne-Caroline Prévot

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Les résultats présentés dans ce chapitre suggèrent cependant que la visite au zoo permet au visiteur un certain dépaysement, une déconnexion d'un quotidien urbain. Pour les visiteurs qui font cette expérience, les zoos sont donc probablement des lieux de ressourcement qui permettent une restauration mentale et psychique (au sens présenté par B. Bonnefoy, cet ouvrage). De plus, les zoos pourraient agir sur la reconnexion à la nature et aux enjeux de conservation de façon très indirecte. Premièrement, nous avons vu que les zoos sont des lieux populaires, fréquentés par des personnes de tous les horizons et avec une forte proportion d'enfants. Connaissant l'importance de l'enfance dans la construction d'une identité environnementale et d'un souci pour la nature (L. Chawla, cet ouvrage), les zoos bénéficient d'une position privilégiée en termes d'éducation à la conservation et d'expérience de nature. Deuxièmement, la visite au zoo a une large composante sociale, via les nombreuses interactions sociales positives que favorisent les animaux. Or, les interactions sociales positives vis-à-vis de la nature participent activement à la création d'un lien individuel à la nature (L. Chawla, cet ouvrage). Enfin, le zoo est source d'attachements. Or, les attachements peuvent entraîner un sentiment d'appartenance, à un lieu ou à une communauté, lui-même source de bien-être et de motivation pour entreprendre des actions futures (B. Bonnefoy, cet ouvrage).

Les parcs zoologiques pourraient donc être des médiateurs vers de nouvelles relations à la nature et à la conservation de la biodiversité, mais pour des raisons sans doute beaucoup plus subtiles que ne le laissent supposer les missions qui leur sont attribuées.

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Appendix 3 :

Article in « Travaux Dirigés pour la Classe »

PSYCHOLOGIE SOCIALE

Une expérience émotionnelle et sociale

Plus que de simples pourvoyeurs de culture scientifique, les zoos sont le théâtre de rencontres et d'échanges, entre le public et les animaux, et entre les visiteurs eux-mêmes.

» PAR AGATHE COLLEDNY, DOCTORANTE, CENTRE D'ÉCOLOGIE ET DES SCIENCES DE LA CONSERVATION, MNHN

18 LE PARC ZOOLOGIQUE DE PARIS • TDC N° 1074

Les parcs zoologiques ont largement évolué depuis leur apparition au XVIII^e siècle. Autrefois principalement destinés à divertir la population et à montrer une certaine domination de la nature à travers l'exposition d'un grand nombre d'espèces exotiques, les zoos tendent de nos jours à reproduire les écosystèmes naturels, dans un souci de bien-être animal, mais aussi de sensibilisation du public.

Informé sans en avoir l'air

Il est maintenant officiellement reconnu que les parcs zoologiques ont quatre missions, qui sont l'éducation, la recherche, la conservation des espèces et le divertissement du public.

Des millions de personnes visitant les zoos chaque année dans le monde, les messages éducatifs qui y sont véhiculés peuvent toucher une population très large et diverse. Les zoos utilisent donc de nombreuses méthodes pour éduquer et sensibiliser le public, que ce soit par des panneaux informatifs ou par des animations interactives. Cependant, les études montrent que, parmi les visiteurs, très peu prennent le temps de s'arrêter pour lire ces panneaux, et qu'il s'agit bien souvent d'un simple coup d'œil, pour relever le nom de l'espèce ou son origine géographique. Nombre d'entre eux les ignorent, estimant déjà connaître l'information – même s'il arrive qu'ils se trompent. D'autres apprécieraient plutôt la découverte visuelle des animaux, sans éprouver le besoin d'en apprendre davantage sur eux.

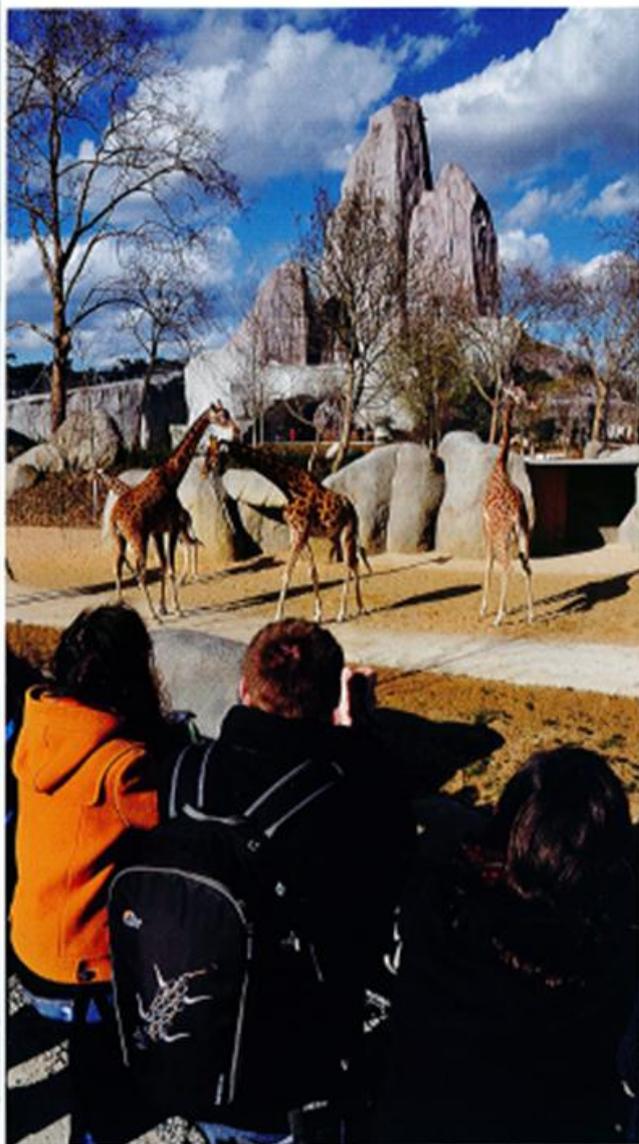
La fascination pour l'animal sauvage

Les collections d'animaux varient grandement en fonction des zoos qui les présentent, et

cela même au sein d'un unique pays. On peut ainsi y découvrir des espèces plus ou moins exotiques, plus ou moins emblématiques ou encore plus ou moins menacées d'extinction. Les visiteurs peuvent donc, s'ils le désirent en apprendre davantage sur les différentes espèces. Mais ils peuvent aussi et surtout observer des animaux vivants, découvrir leur comportement, leurs caractéristiques physiques, et leur odeur. Par rapport à un reportage animalier, la découverte des animaux au zoo a en effet pour valeur ajoutée une qualité multisensorielle : le visiteur peut voir les animaux réels, mais aussi les sentir et les entendre. Le public cherche d'ailleurs souvent à entrer en interaction avec les animaux présentés, en essayant de les toucher, en les pointant du doigt, en les nommant, en essayant de capter leur attention en tapant sur la vitre, en les appelant ou enfin en les imitant.

Voir des animaux procure des émotions, qu'elles soient positives ou négatives. Nous nous sommes tous un jour extasiés devant un animal, pour sa beauté ou sa taille ; le comportement de primates suscite souvent la surprise et le rire ; à l'inverse, des personnes éprouvent de la peur ou du dégoût vis-à-vis de certaines espèces (les serpents peuvent par exemple fasciner certaines personnes, mais en effrayer d'autres), ou même de la tristesse, notamment à cause des conditions de vie des animaux. Il arrive d'ailleurs souvent que le visiteur attribue aux animaux des émotions humaines, parfois même ses propres perceptions, la souffrance de la solitude, par exemple – même si l'animal considéré a un mode de vie solitaire à l'état sauvage. Éprouvant une certaine empathie envers l'animal, il peut ainsi s'imaginer prenant sa place. Il jugera alors de la

Voir des animaux procure des émotions, qu'elles soient positives ou négatives



qualité de ses conditions de vie en fonction de son propre ressenti et non de connaissances éthologiques ou écologiques.

Une image variable de la captivité

Si les conditions de captivité des animaux se sont largement améliorées depuis la création des parcs zoologiques, elles restent tout de même un sujet de controverse. La captivité peut être perçue

^ **Enfants rassemblés devant l'enclos des girafes.**

plus ou moins négativement selon les espèces, paraissant intolérable pour certaines, et non pour d'autres. Ces distinctions ne reposent sur aucun argument rationnel. Les visiteurs les établissent sans connaître, par exemple, les conditions de vie en milieu naturel (nature et taille du domaine vital de l'animal). Et, si de nombreuses personnes semblent se soucier du bien-être animal, déplorant des enclos ou cages trop petits ou non aménagés, elles veulent tout de même voir l'animal lors de leur visite. Or, la captivité est source de stress pour les animaux, et la prise en compte croissante de leur bien-être a amené les zoos à aménager les enclos de telle manière que l'animal puisse, comme il le ferait en milieu naturel, échapper aux humains. Cela implique que l'animal soit moins, voire même non visible par les visiteurs, dont les attentes ne sont alors pas comblées. Un équilibre doit donc être constamment trouvé par les parcs zoologiques entre attentes des visiteurs et bien-être des animaux.

Une expérience sociale

Une équipe de chercheurs a constaté que partager des émotions vis-à-vis des animaux facilite les interactions sociales au sein des groupes de visiteurs, notamment des groupes d'adolescents. Un grand nombre de visiteurs de zoos sont également des familles ou des groupes d'amis, qui viennent partager un agréable moment, que ce soit dans un but éducatif ou non. Ces expériences partagées seront source de souvenirs, positifs ou négatifs, et nombreux sont ceux qui, ayant visité un zoo au cours de leur enfance avec leurs parents, y emmènent leurs enfants à leur tour. Ils peuvent se rendre dans ce zoo précisément, qui les a marqués, mais tout aussi bien dans n'importe lequel, leurs souvenirs renvoyant plutôt à une expérience vécue qu'à un zoo en particulier. Dans une autre étude, des chercheurs ont montré que ces expériences partagées participent à la construction de l'identité de l'enfant. La visite au zoo au cours des premières années serait donc un événement fondateur de l'enfance.

La visite au zoo revêt ainsi de multiples facettes. Si son but premier semble être la découverte d'animaux, à des fins plus ou moins éducatives, son aspect social est également prépondérant, et elle serait un événement important de l'enfance. Des chercheurs ont avancé que l'« identité environnementale », qui qualifie la manière dont chaque individu perçoit et interprète sa relation à l'environnement naturel, se construirait également au cours de l'enfance, d'où l'importance des expériences de nature pendant cette période. ●

SAVOIR

● BARATAY Éric, HARDOUN-FUGIER Élisabeth. Zoos : histoire des jardins zoologiques en Occident (XIV^e-XX^e siècles). Paris : La Découverte, 1998.

Appendix 4 :

Article in « Pour la Science »

Une nouvelle expérience de la nature

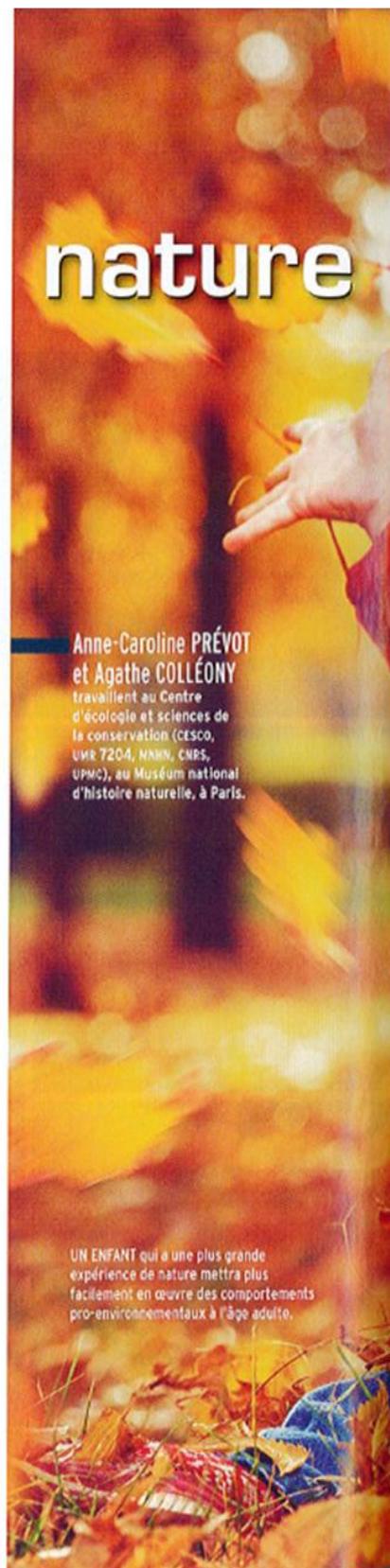
Le réchauffement climatique et la crise environnementale qui l'accompagne menacent nos sociétés et nos modes de vie. Pourtant, nous avons peine à changer nos comportements pour améliorer la situation. Comment expliquer, et surtout résoudre, ce paradoxe ?

En 2015, un sondage *Opinion Waya* a été réalisé pour l'association Fête de la nature auprès de 1 006 Français. Les résultats sont contrastés : certes, 82 % des personnes interrogées trient leurs déchets, mais elles ne sont que 33 % à consommer des produits biologiques, 5 % à financer des associations de protection de la nature, et 4 % à participer à des programmes de sciences participatives. Nous ne sommes guère enclins à modifier nos comportements pour réduire la crise environnementale qui menace la planète. Serions-nous déconnectés de la nature ?

Pourtant, cette crise environnementale menace de façon certaine le fonctionnement de nos sociétés. Les changements climatiques en sont la manifestation la plus médiatisée, mais les menaces sur la biodiversité – on parle de la sixième extinction de masse ! – sont au moins aussi graves pour l'avenir des sociétés. Le danger est important, réel et connu, mais rien n'y fait : la plupart d'entre nous ne se sentent pas ou peu concernés par la crise de la biodiversité. Comment l'expliquer ?

Certains relient ce phénomène à l'urbanisation et aux modes de vie de plus en plus occidentalisés. En effet, une majorité de la population mondiale vit en milieu urbain où le niveau de biodiversité est limité. Les occasions sont donc rares pour les citoyens de faire l'« expérience de la nature » dans leur vie quotidienne. Or cette expérience est un enjeu important, que ce soit pour la santé physique et psychique, ou le bien-être. Mais nous verrons que c'est aussi un enjeu pour la conservation de la biodiversité.

L'étude de la crise de la biodiversité est prise en charge par les écologues de façon explicite depuis une quarantaine d'années avec le développement de la biologie de la conservation. Cette discipline engagée est née du regroupement de nombreuses autres. Les recherches menées dans ce cadre portent entre autres sur les conséquences des changements climatiques sur l'état de l'environnement naturel et sur les dynamiques de la biodiversité. Un autre pan s'intéresse à l'impact des activités humaines sur ces mêmes dynamiques. Ici, des observations de terrain conduisent à des modélisations mathématiques dans lesquelles les activités humaines sont décrites de façon assez grossière, comme des ensembles macro-économiques ou macro-politiques, souvent sous la forme d'indicateurs. Certaines études mettent en évidence les processus actuels, mais d'autres ont aussi des objectifs de prédiction : dans ce cas, il s'agit toujours de l'avenir de la biodiversité soumise à des pressions humaines.



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UN ENFANT qui a une plus grande
expérience de nature mettra plus
facilement en œuvre des comportements
pro-environnementaux à l'âge adulte.



PSYCHOLOGIE

L'ESSENTIEL

- Nous sommes tous conscients des dangers qui pèsent sur la planète.
- Pourtant, nous rechignons à adopter des comportements favorables à l'environnement.
- L'une des explications résiderait dans le manque d'expérience de nature, mais ce n'est pas la seule.
- La réussite du tri des déchets montre que les facteurs en jeu sont nombreux.
- La psychologie de la conservation, une jeune discipline, élucide les mécanismes à l'œuvre dans ces évolutions.

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En lien avec ces travaux, les communautés scientifiques et politiques, soucieuses de l'avenir de la biodiversité et de notre environnement de façon plus générale, encouragent les citoyens du monde à modifier leurs comportements pour réduire la crise environnementale. Or ces campagnes de sensibilisation ont un effet plutôt limité. Le sondage cité en introduction et des indicateurs européens en témoignent. Par exemple, selon l'*Eurobaromètre 2013*, la proportion d'Européens qui connaissent ce qu'est la biodiversité a certes augmenté entre 2007 et 2013, passant de 35 à 44 %, mais elle reste faible. Cinquante-quatre pourcents des sondés déclarent ne pas être informés de la crise de la biodiversité. Seules 38 % des personnes interrogées déclarent agir pour la protection de la biodiversité, et 28 % avouent de rien faire en ce sens.

La réaction naturelle : faire l'autruche

De nombreux travaux, par exemple en psychologie, ont montré depuis longtemps la complexité des comportements humains, notamment vis-à-vis de l'environnement. Les chercheurs et les praticiens savent que les seules injonctions à changer, surtout quand elles ont une forme moralisatrice, ne suffisent pas. D'autres travaux, sur la perception des risques, proposent que les réactions individuelles face à un risque, si elles sont extrêmement variées, dépendent de la conjonction de deux facteurs principaux : la gravité perçue du risque et la perception de sa capacité à y répondre.

En ce qui concerne la menace climatique et la baisse de la biodiversité, la gravité des risques et les changements requis sont tels que la réaction la plus naturelle est... de faire l'autruche ! On entre dans un processus de déni pour continuer sa vie comme si de rien n'était. Ce n'est rien d'autre qu'un mécanisme de défense classique contre un danger qui nous dépasse.

Pourtant, chaque individu, jeune ou non, est capable de modifier ses comportements, et le fait tous les jours. Les chercheurs en psychologie, notamment en psychologie sociale, développent depuis plusieurs années des cadres conceptuels d'analyse de nos comportements et de nos motivations à agir. Les études s'intéressent de façon très fine aux comportements humains, ce qui est extérieur aux individus (facteurs sociaux, culturels, économiques, environnementaux...) devenant des paramètres qui peuvent influencer sur ces comportements.

À l'instar des sciences écologiques qui se sont regroupées pour former la biologie de la conservation dans les années 1980, un groupe de chercheurs

en psychologie s'est rassemblé dans les années 2000 autour des thématiques environnementales. Leur idée était de construire une science engagée vers la conservation de notre environnement, en lien avec les praticiens. Ce fut la naissance de la psychologie de la conservation.

De même qu'en écologie, on cherche à modéliser les comportements humains vis-à-vis de l'environnement naturel. L'objectif est de les comprendre, mais aussi de formuler des projections. Dans ce cas, l'objet central reste l'humain et les variables environnementales interviennent de façon grossière, comme par exemple dans les modèles développés par Stern, Dietz et Schultz, où les niveaux d'inquiétude vis-à-vis des « plantes », des « animaux » et des « oiseaux » sont des mesures de valeur environnementale.

De façon schématique, les modèles les plus employés pour décrire les comportements des individus distinguent les comportements intentionnels de ceux que nous faisons par automatisme, ces derniers étant les plus nombreux. Selon la théorie de l'autodétermination, les actions qui deviennent automatiques sont celles pour lesquelles nous n'avons plus besoin de facteurs externes afin de les réaliser : elles reflètent une partie de nos valeurs, de notre identité.

Pour les autres, celles que nous décidons de façon consciente et réfléchie, plusieurs grandes catégories de motivations entrent en jeu. D'abord les facteurs d'attitude rassemblent les connaissances que nous avons de ce comportement, le sentiment et l'attrait que nous avons pour lui, mais aussi les valeurs que nous avons développées autour de ce comportement et notre identité. Ce sont des facteurs individuels.

Ensuite, la seconde grande catégorie de facteurs de motivation correspond aux normes sociales, c'est-à-dire à ce que font les autres et au « qu'en-dira-t-on ». Nous avons tous tendance à minimiser le rôle de ces facteurs sur nos façons d'agir. Pourtant, des expérimentations ont montré que des citoyens californiens modifiaient leur consommation énergétique en fonction de l'information qu'ils recevaient dans leur boîte aux lettres et indiquant s'ils consommaient plus ou moins que la moyenne de leur quartier.

Nous pourrions gloser sur ces Américains... Mais réfléchissons chacun à notre vie de tous les jours : combien de fois avons-nous fait quelque chose qui nous rendait un peu trop visible aux yeux de nos voisins ? Pensons-nous ou agissons-nous vraiment différemment de nos amis ? Serions-nous prêts à adopter facilement un comportement qui nous attirerait les moqueries

Adopterions-nous un comportement qui attirerait les moqueries d'individus dont l'avis compte pour nous ?

ou les quolibets d'individus dont l'avis compte pour nous ?

Enfin, la troisième grande catégorie de facteurs de motivation concerne notre perception de la facilité de mise en œuvre d'un comportement donné. Nous rechignons à l'adopter quand il est trop compliqué ou coûteux à réaliser, ou bien lorsque nous ne voyons en quoi il est efficace.

Le succès du tri sélectif

Prenons l'exemple du tri des déchets. Les injonctions à séparer les débris recyclables des autres datent de 1975 en Europe, mais n'ont pas été suivies d'effets tout de suite. En France, la mise en place d'un tri sélectif ne date que du début des années 1990. Pourtant, même si cette pratique n'est pas encore systématique, de plus en plus de personnes trient maintenant leurs déchets : 72 % des quelque 28 000 européens interrogés (contre 66 % en 2011) pour l'*Eurobaromètre 2014* le font, et plus ou moins par automatisme, alors que pour la plupart il s'agit d'un changement de comportement.

Une équipe polonaise a même montré que les personnes préféreraient trier elles-mêmes leurs déchets à la maison plutôt que ce soit des tiers qui le fassent ultérieurement, par exemple dans une usine dédiée. Différents facteurs peuvent être avancés pour expliquer ce succès. Les attitudes sont sans doute devenues pro-environnement, 54 % des Européens pensant actuellement que trier les déchets devrait être une priorité de la vie quotidienne pour protéger l'environnement.

Les normes sociales ont aussi probablement changé : il est maintenant socialement acceptable de trier ses déchets dans un grand nombre de milieux. Enfin, un facteur très important est la mise à disposition de plusieurs bacs à domicile pour faciliter la mise en œuvre du tri.

Cet exemple révèle que la question du changement de comportement dépasse le niveau strictement individuel. Certes, la connaissance est importante, mais les pouvoirs publics ont aussi la responsabilité de rendre ces nouveaux comportements faisables. Les normes sociales et les identités collectives peuvent alors prendre leur place dans le processus individuel de changement de comportement.

En effet, le rôle de l'identité dans la mise en œuvre de comportements

est connu. L'identité de chaque individu se construit principalement pendant l'enfance, en fonction des expériences vécues et de l'influence d'adultes référents. L'identité environnementale, définie par la psychologue de la conservation Susan Clayton, est la façon dont nous nous sentons proches et reliés à la nature qui nous entoure. C'est la part de notre identité en lien avec la nature, à côté de notre identité religieuse par exemple. En complément de nos identités personnelles, nous développons également une ou des identités sociales, qui nous mettent en cohérence avec le ou les groupes auxquels nous voulons appartenir. Toutes ces identités font sens pour chaque individu, qui cherche à les mettre en cohérence les unes avec les autres.

Réunir la biodiversité et les humains

Les relations entre les humains et leur environnement dans le contexte actuel de crise sont donc étudiées par la biologie de la conservation et la psychologie de l'environnement, mais de façon indépendante. Ces deux disciplines mettent l'accent sur l'un ou l'autre des partenaires de l'interaction : la biodiversité pour les premiers, les humains pour la seconde. Leurs objectifs sont les mêmes, leurs cadres de pensée sont assez similaires, mais leurs cadres d'analyse sont différents, leurs connaissances sur la partie du système qu'elles n'étudient pas sont extrêmement faibles. Pour finir, elles ne se connaissent et ne se parlent pas.

LE TRI SÉLECTIF (ici des bouteilles en plastique prêtes à être recyclées) est très pratiqué aujourd'hui. Il montre que l'on peut favoriser des comportements pro-environnementaux chez les citoyens.



Une façon de participer à la résolution de la crise environnementale serait pourtant de pratiquer des recherches à l'interface entre ces deux disciplines, recherches qui combindraient les connaissances approfondies des dynamiques de la biodiversité en lien avec les humains et des comportements humains en lien avec la biodiversité.

Ces études seraient « engagées », dans le sens où elles s'attaquent explicitement à une question d'intérêt social à très court terme. Les chercheurs impliqués dans cette démarche ne peuvent pas arguer de leur statut d'intellectuel pour se mettre en retrait des questions sociales. Au contraire, ils devraient engager des travaux en lien avec les acteurs de la société, tout en conservant une exigence scientifique extrême. Ils pourraient également discuter de leurs questions et résultats avec les praticiens de l'environnement, les politiques, les citoyens, les acteurs économiques et autres acteurs influents dans le fonctionnement de la société. Dans cette perspective, nous proposons plusieurs pistes de recherches.

Relier chaque individu à la biodiversité

La première serait de caractériser le plus précisément possible les liens entre comportements et composantes de la biodiversité, et leurs échelles. En effet, si de nombreuses études s'intéressent aux comportements des citoyens vis-à-vis de l'environnement (la consommation d'énergie, le tri des déchets...), peu de travaux se centrent sur les comportements directement en faveur de la biodiversité. Par exemple, réduire la quantité de pesticides dans son jardin entraîne une augmentation des insectes présents dans cet espace; l'effet est direct.

En revanche, le lien entre la consommation de produits biologiques et l'augmentation de la biodiversité des espaces agricoles est plus indirect. Il passe par l'offre et la demande de produits biologiques, qui entraînerait une redistribution des modes de production agricole. Il a lieu aussi à plus grande échelle, un individu seul ne pouvant pas, par sa seule consommation, modifier tout le système de production agricole.

Ces liens entre comportements individuels et dynamique de la biodiversité sont donc par nature très complexes et multifactoriels. Pourtant, il importe de donner une information claire et appuyée sur des données scientifiques aux citoyens. Ils augmentent ainsi leurs connaissances et améliorent leur perception du contrôle, tout en participant à la recréation d'un lien de



confiance entre science et société. Comme il s'agit de données précises sur les dynamiques de la biodiversité, ces travaux seraient principalement conduits par les écologues, avec l'appui de sciences sociales.

Une deuxième piste serait de comprendre les différentes causes sous-jacentes à l'adoption de comportements, individuels et collectifs, en faveur de la biodiversité. On sait par exemple qu'une plus grande expérience de nature au cours de l'enfance augmente la probabilité de mettre en œuvre des comportements pro-environnementaux à l'âge adulte. L'attachement que l'on porte à un lieu peut aussi influencer nos comportements, lorsqu'il s'agit d'actions simples et non coûteuses comme ramasser ses déchets. Cependant, ce n'est peut-être pas le cas lorsque les actions à entreprendre sont plus coûteuses et difficiles à mettre en œuvre.

Une étude australienne a notamment montré que l'attachement à un lieu ne suffisait pas à susciter des comportements de gestion chez des agriculteurs, tel que replanter des espèces natives d'arbres sur leur exploitation. Ainsi, identifier les freins à l'adoption de ces comportements aiderait à ajuster les campagnes de sensibilisation en mobilisant des arguments peut-être plus pertinents. Ici, ces travaux seraient principalement menés par des chercheurs des sciences sociales, puisqu'il s'agit de données centrées sur l'Homme, mais avec l'appui des écologues pour sélectionner les comportements pro-environnementaux pertinents à cibler et valoriser.

Une autre piste réside dans la diversité des approches utilisées pour explorer notre relation à la nature, en investissant les dimensions émotionnelles, sensorielles et virtuelles de la nature. Ainsi, voir des animaux sauvages lors d'une visite au zoo procure des émotions aux visiteurs, qu'elles

MODIFIER L'AGRICULTURE. En privilégiant les produits bio et locaux (a), on modifie, à sa petite échelle, les modes de production agricole au détriment des cultures intensives (b).



soient positives ou plus négatives: la posture ou le comportement d'un animal peut surprendre, faire rire, ou même faire peur. Or, des auteurs ont montré que des personnes ayant vécu une expérience émotionnelle positive au cours d'une visite au zoo seraient par la suite plus enclines à soutenir des projets de conservation.

Tous au zoo !

Par ailleurs, une expérience de nature ne se caractérise pas simplement par la vue d'éléments naturels. Tous nos sens peuvent être plus ou moins mobilisés. Au zoo, on voit l'animal en vrai, mais on l'entend et on le sent aussi, et parfois même on le touche. Or, des émotions et des souvenirs peuvent être suscités par nos sens. Les dimensions émotionnelles et sensorielles restent encore peu explorées dans les études sur la relation à la nature et mériteraient de l'être davantage.

La quatrième piste serait l'extension de l'enseignement et la formation à la recherche en psychologie de la conservation en France, où elle reste encore méconnue. De fait, les recherches en psychologie de l'environnement, présentes aussi en France, se concentrent sur des comportements tels que le tri sélectif ou la consommation d'énergie. Les travaux en lien avec la biodiversité manquent.

Enfin, la dernière piste suppose d'inventer de nouvelles façons d'interagir, où tous les acteurs sociaux pourraient trouver leur place. Nous assistons depuis quelques années à l'essor des sciences participatives (voir *Tous au chevet de la planète*, par R. Julliard, page 90), avec par exemple des programmes de suivi de la biodiversité. Les citoyens collectent les données en suivant des protocoles précis. Si de telles données ont d'ores et déjà permis aux scientifiques de comprendre

les dynamiques de la biodiversité, la participation citoyenne à ces suivis de biodiversité est également un formidable outil de sensibilisation, d'implication et d'éducation du grand public à la conservation de la biodiversité.

Néanmoins, les chercheurs en sciences sociales devraient impérativement s'associer aux écologues pour mieux comprendre la volonté des citoyens à participer à de tels programmes et identifier l'impact que peut avoir une telle implication sur leur niveau de connaissances, de préoccupation envers la biodiversité ou même encore sur leur identité environnementale. D'autres chercheurs vont plus loin en initiant une forme de participation citoyenne, par exemple lors de discussions informelles entre professionnels

et non-professionnels de l'environnement pour construire de nouvelles questions de recherche et discuter de protocoles de recherche. Là encore, écologues et chercheurs en sciences sociales doivent jouer à parts égales.

Pour conclure, si les problèmes environnementaux et de la biodiversité sont très médiatisés, la plupart de nos concitoyens ne répondent pas à ces messages jugés très angoissants. Par des mécanismes de défense inconsciente, ils refusent de se laisser envahir par la peur.

Une façon de réduire le stress est de s'intéresser à des questions plus précises, centrées sur les préoccupations de chacun et en proposant des moyens faciles et efficaces d'agir. En mettant en œuvre ces actions quotidiennes, nous modifions les normes sociales de notre entourage et pouvons encourager implicitement nos proches à adopter les mêmes pratiques. En effet, nous appartenons tous à des groupes divers qui nous inspirent mais que nous pouvons aussi modeler.

Un des enjeux majeurs des questions environnementales reste cependant que les conséquences de nos comportements sur l'environnement ne se verront qu'à long terme, alors même que nous agissons en fonction d'objectifs à court terme. On doit aussi comprendre comment les questions d'environnement peuvent intégrer les identités de chacun, leurs façons de s'intégrer au monde, afin de proposer de nouvelles opportunités pour chacun (enfant ou adulte) de construire ses propres interconnexions, avec les autres mais aussi avec le monde vivant environnant.

Alors, nous pourrions probablement inventer de nouveaux modes d'interactions, d'échanges et de gouvernance, qui augmentent à la fois la qualité de nos environnements naturels et celle de nos modes de vie. ■

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Résumé long en français

Résumé long en français

Résumé long en français

La crise de la biodiversité est aujourd'hui bien reconnue au niveau international. La liste rouge des espèces menacées de L'Union Internationale pour la Conservation de la Nature (IUCN) s'est par exemple enrichie d'un grand nombre d'espèces classées en danger critique d'extinction (CR ; e.g. 168 à 209 espèces de mammifères) ou en danger (EN ; e.g. 31 à 810 espèces d'amphibiens) entre 1996 et 2015 (IUCN 2015). Le taux actuel d'extinction des espèces est beaucoup plus important que les taux d'extinction datant des précédentes crises majeures d'extinction de la biodiversité, c'est pourquoi certains chercheurs ont proposé que nous faisons actuellement face à une 6^{ème} crise majeure d'extinction (Barnosky et al. 2011). Cependant, la crise de la biodiversité n'est pas seulement une extinction d'espèces, mais plus globalement une diminution de l'abondance et une réorganisation des interactions entre espèces et avec leur environnement. Selon l'IUCN et le World Wide Fund (WWF), les causes principales du déclin des espèces sont toutes dues aux activités humaines et incluent la disparition, dégradation et fragmentation des habitats, la surexploitation, les changements climatiques, la pollution et l'introduction d'espèces exotiques envahissantes (IUCN 2015; WWF 2016). Par la destruction et la fragmentation des habitats naturels, l'urbanisation est une des menaces (Kerr and Currie 1995). En effet, les niveaux de biodiversité sont largement réduits dans les espaces urbains (McKinney 2002). La crise de la biodiversité, c'est-à-dire la modification de la composition des communautés naturelles et des processus écologiques, a des effets néfastes sur le fonctionnement des écosystèmes et, en retour, sur les services que les écosystèmes fournissent aux humains (Cardinale et al. 2012). Le besoin urgent d'enrayer la crise de la biodiversité a donc largement été mis en avant, pour diverses raisons : alors que les valeurs intrinsèques (protéger la nature pour ce qu'elle est) et utilitaires (protéger la nature pour ce qu'elle fournit aux humains) ont largement été mises en exergue, d'autres raisons de protéger la nature ont été proposées, comme par exemple des raisons éthiques, ou la considération des relations entre les humains et la nature. Par exemple, May (2011) propose que, en plus de préserver les espèces car beaucoup n'ont pas encore été découvertes ou bien étudiées et dont les gènes pourraient être jugés utiles par les biotechnologies et de préserver les écosystèmes parce que les humains dépendent des services qu'ils fournissent, les humains ont la « responsabilité de transmettre aux générations futures une planète aussi riche de merveilles naturelles que celle dont nous avons hérité » (May 2011, p.349). Plus récemment,

Résumé long en français

Chan et collaborateurs (2016) ont suggéré que considérer la protection de la nature pour les services qu'elle rend aux humains (valeur instrumentale) ou pour ce qu'elle est (valeur intrinsèque) n'est pas suffisant, et qu'une troisième classe de valeurs devrait être ajoutée : les valeurs relationnelles : relations entre les humains et la nature, et entre personnes qui impliquent la nature.

Pour faire face à la crise de la biodiversité, un grand nombre d'états s'est accordé à établir une Convention pour la Diversité Biologique (CDB) à la Conférence des Nations Unies sur l'Environnement et le Développement (« Sommet de la Terre » à Rio) en 1992 ; cette convention avait reçu 168 signatures en 1993. En 2010, un second plan stratégique pour la biodiversité 2011-2020 a été défini par la CDB pour enrayer la perte de biodiversité sur la planète, qui propose cinq buts stratégiques et 20 objectifs appelés « Aichi Biodiversity Targets », dont certains incluent la prise en compte des sentiments et comportements humains dans les objectifs de conservation ; par exemple, le premier objectif statue que « d'ici 2020 au plus tard, les humains seront conscients des valeurs de la biodiversité et des étapes qu'ils doivent suivre pour la conserver et l'utiliser de manière durable » (Convention for Biological Diversity 2010). Cela témoigne bien d'une prise en compte globale de la crise de la biodiversité et de la place de l'humain au sein de ces enjeux.

En parallèle de la mobilisation politique internationale, la crise de la biodiversité a conduit au regroupement d'un grand nombre de disciplines autour de l'écologie scientifique, dans le but de former une discipline de « crise », la *biologie de la conservation*, qui s'attache à fournir des principes et outils pour préserver la biodiversité (Soulé 1985). Cette discipline se concentre largement sur l'impact des changements climatiques et des activités humaines sur la biodiversité et ses dynamiques. Cependant, les recherches centrées sur l'impact de la biodiversité sur les humains, pour la santé, le bien être individuel et les enjeux de conservation (e.g. recherche dédiée aux comportements respectueux de l'environnement) apparaissent depuis peu dans ce champ. En effet, les biologistes de la conservation se sont plus récemment accordés à dire que les problèmes liés à la conservation ne pourraient être résolus uniquement par des connaissances en écologie (Mascia et al. 2003), et que plus de sciences sociales sont essentielles pour répondre efficacement aux enjeux de conservation (Lidicker 1998 dans Saunders 2003). De manière très similaire à la *biologie de la*

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conservation, la *psychologie de la conservation* a émergé de diverses disciplines des sciences sociales autour de la psychologie, pour « renforcer les liens entre les sciences naturelles et les sciences sociales, entre la recherche et la pratique, et entre la psychologie et les autres sciences sociales » (Saunders 2003 p.137). Ce nouveau champ de recherche et d'action est dédié à la compréhension des relations réciproques entre les humains et la nature, dans un but ultime d'encourager la conservation du monde naturel (Saunders 2003). De ce point de vue, la *psychologie de la conservation* est aussi une discipline engagée.

De nombreuses études se sont intéressées aux relations Homme-Nature, en explorant la manière dont les humains se sentent faire partie du monde naturel (voir Tam 2013 pour une revue des concepts existants). Par exemple, W. Schultz a proposé une mesure de relation à la nature : *l'Inclusion de la Nature dans le Soi (INS)* est basée sur le principe statuant qu'une personne qui se sent connectée à une autre personne est susceptible de se représenter un schéma cognitif de cette relation, en visualisant le chevauchement entre la connaissance de soi et la connaissance du partenaire dans cette relation (Aron et al. 1991). S. Clayton a proposé une mesure de *l'Identité environnementale (EID)*, sous la forme d'une liste de 12 items, qu'elle définit comme le sentiment de connexion avec l'environnement non-humain, qui affecte la manière dont les individus perçoivent et agissent envers le monde, et la croyance que l'environnement est important et forme une part conséquente dans le soi (Clayton 2003). Ces mesures de connexion à la nature sont fortement corrélées (Schultz 2001) à une mesure d'orientation pro-environnementale plus connue, l'échelle du *Nouveau Paradigme Environnemental (NEP)* de Dunlap et Van Liere (Dunlap and Liere 1978; Dunlap et al. 2000), suggérant que toutes ces échelles examinent des aspects communs du sentiment de connexion à la nature.

Malgré une large diversité de mesures, les tentatives de définition du sentiment de connexion à la nature reposent sur la manière dont les personnes perçoivent et apprécient le monde naturel, plutôt que sur la manière dont elles l'expérimentent physiquement. Ce dernier aspect n'a été pris en considération que dans la mesure de *Relation à la nature* (e.g. un des items de la mesure est « J'aime creuser la terre et avoir de la boue sur les mains »)

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(Nisbet, Zelenski, and Murphy 2009). Le concept d'expérience de nature est mobilisé dans la littérature depuis plus de 20 ans, notamment au travers de l'hypothèse d'extinction de l'expérience (voir plus loin) (Pyle 1978; Pyle 2003; Miller 2005; Soga and Gaston 2016), sans avoir jamais clairement été défini. Soga et Gaston (2016) font bien référence à la « large diversité de types d'interactions entre les humains et la nature » et se sont largement référés aux contacts avec la nature dans la revue de littérature qu'ils ont réalisée, mais sans différencier clairement expérience et contacts. Or, l'« expérience » se définit comme le « processus d'acquisition de connaissances et de compétences, en faisant, voyant ou éprouvant des choses » ou comme « quelque chose qui vous arrive et qui affecte la manière dont vous vous sentez » (<http://dictionary.cambridge.org/fr/>). Ainsi, l'« expérience de nature » ne se limite pas aux simples contacts avec le monde naturel, mais serait également un processus qui affecte les personnes plus profondément. Il existe une large diversité d'expériences de nature, qui varient d'un individu à un autre. Bien évidemment, relations avec la nature et expériences de nature sont intimement liées, puisque par exemple, les expériences de nature pendant l'enfance affectent fortement l'identité environnementale (Chawla 1988).

Le déclin actuel de biodiversité et nos modes de vie de plus en plus urbains diminuent progressivement les opportunités d'expériences de nature dans les pays occidentaux. En effet, 80% de la population dans les pays Européens se concentre dans les zones urbaines (Antrop 2004; United Nations 2011), et les citoyens des sociétés occidentales passeraient 90% de leur temps à l'intérieur de bâtiments (Evans and McCoy 1998). De plus, les personnes vivant relativement loin d'espaces naturels interagissent moins fréquemment avec la nature (Soga et al. 2015) ; de nombreuses études ont également montré que les enfants de nos jours passeraient moins de temps à interagir avec le monde naturel, en comparaison avec les générations précédentes (voir Soga and Gaston 2016 pour une revue de la littérature). Cette perte d'opportunités d'expérience de nature conduit inévitablement à une réduction d'interactions directes entre les humains et la nature. Pyle (1978; 2003) a qualifié ce phénomène d'« extinction de l'expérience », et l'a décrit comme l'habitude croissante des humains à l'absence d'espèces communes de plantes et d'animaux qui se raréfient de l'environnement quotidien. Plus récemment, Soga et Gaston (2016) ont mis en

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avant que la perte d' « orientation », ou de volonté, envers le monde naturel, est aussi un important facteur dans la réduction des contacts avec la nature. En effet, il a été montré que le niveau de connexion émotionnelle à la nature d'un individu est positivement corrélé avec sa fréquence de visite d'espaces de nature (Mayer and Frantz 2004; Nisbet, Zelenski, and Murphy 2009). Selon Soga et Gaston (2016), alors que l'extinction de l'expérience est causée par la perte d'opportunités et d'orientations, la réduction des interactions entre les humains et la nature a des conséquences sur leur santé et leur bien-être, ainsi que sur les émotions et attitudes envers le monde naturel, qui, à leur tour, affectent les comportements; ces conséquences ont des effets rétroactifs sur les causes de l'extinction de l'expérience, et peuvent ainsi accélérer celle-ci. Les bénéfices d'une relation intime avec la nature ont pourtant largement été montrés, que ce soit pour la santé humaine (Mitchell and Popham 2008), le bien être individuel (Howell et al. 2011), la restauration de l'attention (Kaplan and Kaplan 1989), ou les enjeux environnementaux. C'est pourquoi Miller (2005) a souligné le besoin urgent de reconnecter les humains avec la nature pour mener à bien les objectifs de conservation, en augmentant les opportunités et orientations envers le monde naturel en tandem (Soga and Gaston 2016).

Cependant, comme mentionné ci-dessus, l' « expérience » fait référence à plus que de simples contacts avec la nature. « Reconnecter » les citoyens à la nature fait ici référence au besoin de restaurer la relation plus intime avec la nature que les citoyens avaient dans les décennies précédentes. En effet, si les humains ont de nos jours moins d'opportunités et de volonté d'être en contact direct avec la nature, il apparaît nécessaire de renforcer le sentiment de connexion à la nature, en créant de (nouvelles) opportunités d'expériences de nature, et en augmentant leur volonté à le faire. Les expériences de nature actuelles sont sans doute très différentes de celles des générations futures, avec le développement de nouvelles technologies et le changement de modes de vie. Plutôt que de s'acharner à vouloir une relation idéalisée, reconnecter les citoyens à la nature en restaurant une relation intime entre les humains et la nature, pourrait se faire en favorisant les expériences actuelles de nature plutôt qu'en se concentrant exclusivement sur les expériences que les citoyens avaient avec la nature dans les décennies précédentes.

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Les nombreuses études qui ont exploré les bénéfices de la nature pour les humains ont fait référence à différents types de « nature » : la plupart se sont appuyées sur des comparaisons entre environnements « urbains » et « naturels » (e.g. Bratman et al. 2015), entre différents paysages (Han 2010) ou entre différents niveaux de « vert » (Mitchell and Popham 2008). Les espaces naturels étudiés dans ces travaux sont donc souvent définis d'une manière très imprécise, et peu d'études ont exploré les catégories de paysages les humains visitent réellement et à quelles proportions. Parallèlement, alors que les espaces naturels sont bien catégorisés et spécifiés dans la littérature scientifique et de gestion de la nature, nous en savons encore très peu sur ce que les personnes définissent comme « espaces de nature ». En effet, il est normal que la définition de la nature reste si floue, puisqu'il n'y a déjà pas de consensus parmi les écologues et biologistes de la conservation : diverses typologies ont été proposées pour classifier les habitats Européens (e.g. Corine Land Cover: IGN 2012), et par exemple, la contribution de la phytosociologie dans la définition d'une typologie des habitats reste controversée (Hall, Krausman, and Morrison 1997; Boitani, Mace, and Rondinini 2015). Pourtant, augmenter les volontés et opportunités d'expériences de nature requiert d'identifier au préalable le type d'espaces de nature que le public utilise déjà. En tant que partie intégrante de ma thèse, j'ai donc exploré les habitudes de pratiques d'espaces de nature d'un large échantillon d'enquêtés français (N=4 639). J'ai pu obtenir une telle taille d'échantillon en regroupant les données de cinq enquêtes indépendantes mais toutes centrées sur une meilleure connaissance des relations entre les humaines et la nature. Les groupes étudiés étaient les suivants : (1) 1 126 étudiants de diverses disciplines (i.e. biologie, écologie, mathématiques et sciences politiques), (2) 1 172 joueurs adultes d'un jeu de rôle en ligne (World of Warcraft®), (3) 446 visiteurs de zoos en France, (4) 342 répondants à un questionnaire en ligne diffusé par le biais de la technique boule de neige (Biernacki and Waldorf 1981) ou par le biais de réseaux sociaux (Facebook®), et (5) 1 553 personnes ayant participé à un programme d'« adoption d'un animal » au zoo de Paris. Chaque personne devait indiquer sa fréquence de visite d'espaces de nature, ainsi que les espaces de nature dans lequel il/elle se rend le plus souvent, sous la forme d'une question ouverte.

Nous avons obtenu un total de 7 761 citations d'espaces de nature, puisque les répondants étaient autorisés à fournir plusieurs réponses. Le regroupement de lieux identiques a

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conduit au nombre de 678 espaces de nature différents. Nous avons trouvé que 16 de ces espaces de nature étaient mentionnés par au moins 50 personnes (i.e. 5 912 réponses), et donc représentaient 76,2% de la totalité des espaces cités. Plus spécifiquement, les cinq espaces les plus cités représentaient 54% (i.e. 4 194 réponses) des espaces mentionnés, ce qui suggère un attrait commun pour ces espaces parmi tous les enquêtés. Il s'agit dans l'ordre des forêts, des parcs, de la campagne, des montagnes et des jardins. Le premier résultat de cette étude est donc que les adultes français partagent un attrait commun pour un nombre restreint de lieux qu'ils qualifient de « nature ». Cependant, au-delà de ces cinq espaces les plus cités, une large variabilité dans ce que les personnes mentionnent comme « espaces de nature » a été trouvée, certains espaces cités n'étant pas considérés comme « naturels » d'un point de vue écologique par les biologistes de la conservation. C'est le cas par exemple des terrains de golf, dont la mise en place requiert souvent la modification des habitats naturels, et dont la gestion implique l'utilisation excessive de produits chimiques et d'eau ; notons cependant que, récemment, les terrains de golf ont commencé à être pris en compte comme support de biodiversité (Colding and Folke 2008). Puisqu'ils n'accueillent pas de hauts niveaux de biodiversité, la valeur de tels espaces est difficilement considérée dans les politiques de conservation. Néanmoins, ils accueillent tout de même des espèces de plantes et d'animaux, et, plus important, ils sont considérés comme de la nature par les non scientifiques. De tels lieux sont donc des espaces où le public peut avoir des expériences de nature ; ils devraient donc être considérés plus minutieusement dans les politiques de conservation et la gestion des espaces naturels, pour leur fort potentiel à reconnecter le public à la nature et aux préoccupations pour la biodiversité.

Le deuxième résultat de cette étude lie les habitudes actuelles des personnes interrogées avec leur histoire personnelle de pratiques d'espaces de nature. Nos résultats suggèrent fortement que les expériences de nature pendant l'enfance déterminent le type d'espace de nature visité à l'âge adulte (espace forestier ou plus urbanisé), ainsi que la manière dont les personnes parlent de ces espaces qu'ils visitent : les individus qui ont grandi dans des espaces plus ruraux iraient plus souvent dans les forêts (l'opposé pour les personnes ayant grandi en ville) ; de plus, les personnes ayant grandi en milieu plus rural resteraient plus généraux en mentionnant un type d'espace (e.g. forêts), pendant que les personnes ayant

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grandi en zones plus urbanisées mentionneraient des lieux plus spécifiques (e.g. Forêt de Fontainebleau). Ces résultats suggèrent que, en plus de la connexion à la nature (montré par Chawla 1988), les expériences de nature pendant l'enfance auraient un impact sur les expériences de nature à l'âge adulte et sur la représentation que les adultes se font de la spécificité du lieu.

Un aspect important de la reconnexion du public avec la nature et les enjeux de conservation, ou autrement dit de la restauration d'une relation plus intime entre les humains et la nature, est donc de fournir au public plus d'opportunités pour diverses expériences de nature, y compris les nouvelles. Néanmoins, de plus en plus d'études ont montré que la végétation est souvent distribuée inégalement dans les villes, avec des niveaux réduits de végétation pour les populations de milieux défavorisés, minorités ou autres populations (e.g. Pham et al. 2012; Landry and Chakraborty 2009). Cependant, notre étude des pratiques d'espaces de nature par le public a révélé qu'un grand nombre de lieux a le potentiel de fournir des expériences de nature, même si ces mêmes espaces de sont pas considérés comme « naturels » du point de vue écologique par les biologistes de la conservation. Il apparaît donc important de considérer ces lieux qui peuvent potentiellement fournir des expériences de nature à un large public. C'est le cas des zoos. En effet, même si ceux qui ont mentionné les zoos comme espaces de nature dans notre enquête étaient majoritairement des personnes directement concernées (visiteurs de zoo et personnes ayant « adopté » un animal au zoo), cela signifie tout de même que les personnes qui visitent les zoos considèrent ces lieux comme naturels. La visite au zoo pourrait donc être considérée comme une expérience de nature, qu'elle soit locale ou plus exotique, indépendamment de l'artificialité de la « nature » montrée au zoo. Cette perception du zoo comme un espace de nature pourrait s'expliquer par deux éléments : les animaux montrés et leur environnement naturel, que les paysagistes tendent à recréer.

Les zoos n'ont pas toujours été créés pour être immersifs. A l'inverse, les animaux des premiers zoos étaient rassemblés en grand nombre dans de petites cages ou enclos

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entièrement bétonnés. Le but était alors de présenter des animaux exotiques et d'évoquer la domination des humains sur les animaux, et au travers de cela, une domination sur le monde naturel (Baratay and Hardouin-Fugier 1998). La vision de la relation entre les humains et la nature a évolué au cours du temps, avec une considération croissante des humains comme part intégrante du monde naturel, et non plus simplement comme dominant celui-ci (Derex 2012). De la même façon, les zoos ont progressivement changé de statut : au départ simples lieux de divertissement où le public pouvait observer une large diversité d'animaux exotiques, ils sont devenus de réels centres de conservation des espèces (Rabb 2004). De plus, la préoccupation grandissante vis-à-vis du bien-être animal a poussé les zoos à améliorer les conditions de captivité. En effet, de nombreux visiteurs jugent le bien-être animal simplement sur ce qu'ils voient pendant la visite : le style des enclos et le comportement des animaux (Coe 1989 dans Melfi, McCormick, and Gibbs 2004). Les zoos ont donc investi beaucoup dans l'enrichissement environnemental, défini comme l'amélioration du fonctionnement biologique des animaux captifs, par des modifications dans leur environnement (Newberry 1995). Par exemple, une plus grande quantité de végétation peut être incluse dans les enclos, pour que ceux-ci ressemblent le plus possible à l'environnement naturel de l'animal (i.e. « naturalisé ») ; plusieurs objets ou dispositifs peuvent aussi être proposés à l'animal pour stimuler son intérêt et lui donner la possibilité d'exprimer des comportements typiques de son espèce. Cependant, un juste équilibre est nécessaire entre la valeur esthétique de l'enclos et son utilité fonctionnelle, puisque de précédentes études ont noté que dans le type d'enclos naturalisé le plus commun, les occupants n'avaient souvent pas accès à la majorité de la végétation (Seidensticker and Doherty 1996 dans Melfi, McCormick, and Gibbs 2004). C'est pourquoi, même si les objets ou dispositifs d'enrichissement utilisent souvent des matériaux artificiels, les zoos essaient souvent de les faire paraître le plus naturels possible : ils augmentent le bien-être animal en offrant au regard du public l'illusion d'un habitat naturel des animaux présentés. De plus, avec les dispositifs d'enrichissement, les animaux présentés sont plus susceptibles d'exprimer un large spectre de comportements typiques de l'espèce et sont attractifs pour les visiteurs (Robinson 1998). Les enquêtes auprès des visiteurs de zoos montrent d'ailleurs que ceux-ci préfèrent les enclos naturalisés (Reade and Waran 1996; Tofield et al. 2003), et

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que ces enclos seraient plus efficaces que les moins naturalisés pour augmenter les préoccupations du public envers les animaux (Lukas and Ross 2014).

Les zoos affichent progressivement d'autres rôles que simplement le divertissement du public : d'abord, ils annoncent officiellement qu'ils agissent pour la conservation, au travers des programmes d'élevage en captivité pour maintenir la diversité génétiques des espèces (WAZA 2015). Depuis 1993, le potentiel des zoos pour la conservation au cours de la Convention pour la Diversité Biologique (CBD) est mondialement reconnu, ce qui oblige les zoos à assumer leur rôle de conservation in-situ et ex-situ sous les exigences de la CBD (Rees 2005), même sans soutien financier systématique de la part des gouvernements (Gippoliti 2012). Cependant, la contribution des zoos à la conservation des espèces reste controversée, notamment au sein de la communauté scientifique, principalement car les collections animales dans les zoos sont majoritairement composées de grands vertébrés et d'espèces peu menacées ou peu endémiques (Balmford, Leader-Williams, and Green 1995; Conde et al. 2011; Fa et al. 2014; Martin et al. 2014; Frynta et al. 2013). Or le fonctionnement financier de nombreux zoos dépend largement des entrées payées par les visiteurs (Mazur and Clark 2000), ce qui explique que l'une des stratégies utilisée est de montrer des animaux que le public apprécie et s'attend à voir en allant au zoo. De nombreuses études ont ainsi montré que certaines espèces sont préférées : le public semble passer plus de temps devant les enclos de grands vertébrés, majoritairement des mammifères (Moss and Esson 2010), il est plus enclin à dépenser de l'argent et des efforts pour voir des espèces rares (Angulo et al. 2009), et il montre un attrait général pour les primates, du fait de leurs similarités avec les humains (Plous 1993). Néanmoins, même si la contribution des zoos à la conservation ex-situ (i.e. dans les zoos ou jardins botaniques) reste incertaine, les zoos sont les principaux contributeurs financiers aux programmes de conservation in-situ, sur le terrain (Gusset and Dick 2011).

L'éducation, et plus spécifiquement l'éducation à la conservation, est un autre aspect important de la culture du zoo. En effet, avec la conservation directe des espèces menacées, l'éducation à la conservation est un thème important dans les déclarations sur les missions de 136 zoos dans le monde (Patrick et al. 2007). Et de fait, certains chercheurs proposent que les zoos sont une source d'apprentissage informel, c'est-à-dire dirigé par l'individu lui-

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même, volontaire, en fonction de ses intérêts (Tofield et al. 2003). Les zoos utilisent de nombreux moyens diversifiés pour délivrer des messages sur la conservation : panneaux informatifs, dispositifs interactifs ou activités, rencontres avec des soigneurs ou des volontaires. Certains panneaux présentent des informations, sur la biologie de l'animal présenté, sur la conservation des espèces en général, ou sur le concept d'enrichissement environnemental ; d'autres panneaux tentent d'aider les visiteurs à se sentir liés aux animaux, en mettant en avant les menaces d'extinction par exemple (Tofield et al. 2003). Cependant, très peu de visiteurs lisent les panneaux, et ceux qui le font ne les lisent que très brièvement (Clayton, Fraser, and Saunders 2009; Tofield et al. 2003). Le design des enclos est un autre élément important de l'apprentissage informel : les enclos naturalisés susciteraient davantage l'intérêt des visiteurs que des enclos moins naturalisés, intérêt qui permet des observations et un apprentissage (Tofield et al. 2003). Ainsi, les zoos, au travers d'une diversité de media éducatifs, fourniraient une source efficace d'apprentissage. D'ailleurs, une récente étude à large échelle a montré que les visiteurs de zoos, autant adultes qu'enfants, sortiraient du zoo avec une plus grande connaissance sur la biodiversité (Jensen 2014; Moss, Jensen, and Gusset 2015).

Les zoos attirent des millions de visiteurs tous les ans dans le monde (Gusset and Dick 2011), avec de nombreux groupes, familles ou amis, désireux de partager une expérience de rencontre avec l'animal. La composante sociale de la visite au zoo a largement été montrée, puisque les animaux de zoo élicitent des réponses émotionnelles, qu'elles soient positives ou négatives, et que le partage de ces émotions favorise les interactions sociales (Clayton, Fraser, and Saunders 2009; Fraser et al. 2009). Il a même été montré que les visiteurs qui ont ressenti de fortes émotions positives envers les animaux captifs étaient plus susceptibles de soutenir des projets de conservation (Kals, Schumacher, and Montada 1999; Allen 2002; Hayward and Rothenberg 2004; Myers, Saunders, and Birjulin 2004). Cependant, les attitudes des visiteurs envers les animaux sont très complexes. En plus de leur attractivité exotique, les animaux de zoo permettent au public de considérer sa condition animale (Servais 2012) et d'observer leur propre animalité sauvage (Cosson 2007). Plus précisément, les animaux n'élicitent pas tous les mêmes réponses émotionnelles : par exemple, le public ressent en général de la peur ou de l'aversion pour les invertébrés (Kellert 1993), alors que

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les primates sont globalement perçus positivement, principalement du fait de leurs similarités avec les humains (Plous 1993). Une étude administrée à 2 134 participants à un programme de parrainage d'animal au Parc Zoologique de Paris a montré qu'en moyenne, les personnes avaient ressenti de plus hauts niveaux d'émotions positives (intérêt, fascination, fierté, joie et plaisir ; moyenne = 3.9 sur une échelle en 5 points de 1 très peu à 5 beaucoup) que d'émotions négatives (tristesse, peur, honte, colère et anxiété ; moyenne = 1.4). Des résultats similaires ont été observés auprès de 84 visiteurs de la Ménagerie, un autre zoo de Paris.

En plus de fournir des expériences émotionnelles et sociales, les animaux de zoos permettent également aux visiteurs de vivre une expérience multi sensorielle : en effet, en comparaison aux médias de masse (e.g. télévision, internet), le zoo permet aux visiteurs de vivre une expérience de rencontre tridimensionnelle avec les animaux, puisqu'ils peuvent les voir en vrai, les entendre, les sentir et parfois même les toucher (Rabb 2004). Cette expérience sensitive participe au sentiment d'immersion du visiteur dans le zoo : Ogden et collaborateurs (1993) ont exploré l'impact des sons naturels sur le sentiment d'immersion des visiteurs d'un zoo, en émettant artificiellement des sons naturels au niveau des enclos dans un zoo. Ils ont ainsi observé une augmentation de la prise en compte de l'environnement naturel, de l'apprentissage global et de l'apprentissage sur les interactions animal-environnement quand les sons naturels étaient émis, par rapport aux situations dans lesquelles les hauts parleurs étaient éteints. Et effectivement, les zoos sont de plus en plus créés de manière à immerger les visiteurs le plus possible dans l'habitat des animaux, pour leur donner l'impression d'une rencontre avec l'animal aussi proche que possible d'une rencontre avec un animal dans la nature (i.e. concept de paysage immersif : Coe 1985). Cela donne aussi l'opportunité aux visiteurs de ressentir une évasion de leur vie quotidienne, un besoin de plus en plus exprimé par les citoyens du fait de plus hauts niveaux de stress et de mal-être psychique dans les environnements urbains (Ulrich et al. 1991). Cependant, le public doit-il nécessairement ressentir une évasion lointaine vis-à-vis de son environnement quotidien, au travers de l'immersion dans l'environnement des animaux exotiques montrés au zoo, ou l'environnement naturel global du zoo, y compris la biodiversité urbaine, participe-t-il dans le sentiment d'immersion et sentiment d'évasion ? En quoi expérimenter

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l'exotisme est-il important, intéressant ou contre-productif en termes de reconnexion aux enjeux de conservation de la biodiversité ?

Dans un contexte de crise de la biodiversité et l'importance de restaurer une relation intime entre les humains et la nature, de nombreuses études se sont intéressées à comment reconnecter les citoyens à la nature et aux enjeux de conservation. Au vu des composantes diverses et multiples de la visite au zoo mentionnées précédemment, et la large perception du zoo comme espace de nature, il apparaît justifié de considérer les zoos comme des lieux possibles de reconnexion à la nature et aux enjeux de conservation. Tout d'abord, les zoos pourraient aider à augmenter la connaissance du public sur la biodiversité et sa conservation au travers de l'éducation à la conservation. Cependant, les aspects multi sensoriels, sociaux et mémoriaux de la visite au zoo pourraient aussi avoir un impact sur la relation individuelle à la nature, d'un point de vue plus affectif : en effet, les expériences émotionnelles positives et sociales fournies par la visite au zoo pourraient augmenter l'appréciabilité du public pour le monde naturel, et sa volonté d'avoir plus d'expériences de nature, et de préserver celle-ci. Ce projet de thèse s'attache donc à explorer le potentiel des zoos dans la reconnexion des citoyens avec la nature et les enjeux de conservation. Plus précisément, je me suis attachée à explorer si le zoo était perçu comme un espace de nature, quelle nature y était perçue, et s'il pouvait contribuer à modifier le sentiment de connexion à la nature, ainsi que les comportements en faveur de la conservation des espèces. J'appuie cette réflexion sur les travaux que j'ai menés dans les trois zoos appartenant au Muséum national d'Histoire Naturelle à Paris : la Ménagerie du Jardin des Plantes, le Parc Zoologique de Paris et la Réserve de la Haute-Touche.

Ce travail de thèse est présenté sous la forme de 6 manuscrits (4 manuscrits soumis, 1 en phase de soumission et 1 en préparation) et est présenté suivant le cheminement suivant :

1. La crise de la biodiversité et les modes de vie de plus en plus urbains ont largement réduit les opportunités d'expérience de nature, et la volonté d'en avoir. Or, pour restaurer

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une relation plus intime entre les humains et la nature, en favorisant les opportunités d'expérience de nature, il convient tout d'abord de savoir quels espaces de nature sont déjà utilisés par le public. Ainsi, dans le premier article intitulé « Quel type de gestion à l'échelle paysagère peut enrayer l'extinction de l'expérience ? » (soumis à *Landscape and Urban Planning*), mes collègues et moi soulignons la multiplicité d'espaces de nature utilisés par un large échantillon de Français, ainsi qu'un attrait commun pour un faible nombre de ces espaces. Nous démontrons que même des espaces non considérés comme naturels par les biologistes de la conservation sont perçus et utilisés comme espaces de nature par le public, par exemple les zoos. Enfin, nous montrons que les expériences de nature pendant l'enfance ont un impact sur le type d'espaces de nature utilisés à l'âge adulte (forestier ou plus urbanisé) et sur la manière dont les personnes parlent des espaces de nature qu'ils fréquentent.

2. Dans l'article « Transformation de l'expérience : vers une nouvelle relation à la nature » (soumis à *Frontiers in Ecology and the Environment*), nous revenons sur le concept d'« extinction de l'expérience » de nature, en avançant que par définition, l'expérience est plus que les simples contacts avec la nature, comme défini dans la littérature, et qu'elle implique des changements plus profonds chez les individus, qui s'ancrent dans leur identité. Nous montrons qu'il ne s'agit pas actuellement forcément d'une extinction de l'expérience, mais plus probablement que l'expérience de nature a récemment évolué avec nos modes de vie. Nous détaillons les différentes dimensions de l'expérience de nature, et proposons de prendre en compte les expériences de nature dans leur diversité et leur complexité. Enfin, nous soulignons l'importance de prendre en compte la dimension sociale de l'expérience de nature, pour une meilleure interconnexion de la nature, de l'individu et de la société.

3. L'article « Que signifie 'nature' au zoo ? » (en préparation) analyse le contenu de photographies de ce que les visiteurs au zoo considèrent comme nature. Cette analyse montre que l'accent est largement mis sur les espèces animales captives, en particulier les mammifères, plutôt que sur la végétation seule ou le paysage plus globalement. Nous montrons également que le zoo semble perçu par les visiteurs comme plus naturel qu'un parc urbain, mais moins qu'une forêt ou que l'Amazonie, suggérant que la perception de la nature suit un gradient en fonction du niveau de gestion des espaces. Enfin, nous concluons

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que la nature au zoo semble perçue très majoritairement par le biais des espèces captives, et que la biodiversité urbaine qui peut être présente dans le zoo ne semble pas du tout prise en compte.

4. Dans l'article « Exploration anthropologique du paysage sonore dans les zoos : l'exotisme comme médiateur de l'expérience quotidienne de nature » (soumis à *Landscape and Urban Planning*), nous montrons, au travers d'une étude anthropologique de la perception du paysage sonore dans les zoos, qu'à l'inverse, la biodiversité urbaine semble bien perçue par les visiteurs, et que cette perception est favorisée par l'attention portée aux espèces exotiques présentées au zoo. Nous mettons également en évidence que les sons humains sont perçus négativement s'ils empêchent l'immersion, mais aussi positivement s'ils permettent le partage d'une expérience. Enfin, nous montrons que les sons humains et les sons naturels, issus des espèces captives et non captives, participent au sentiment d'immersion des visiteurs dans un « ailleurs », et permettraient ainsi une déconnexion du milieu urbain.

5. Dans l'article « La visite au zoo peut-elle lier la connexion à la nature aux préoccupations pour la biodiversité ? Analyse comparative entre zoos et parcs dans Paris, en France » (en phase de soumission à *Journal of Environmental Psychology*), nous montrons, à l'aide d'une analyse comparative entre visiteurs de zoos et visiteurs de parcs urbains, que les visiteurs de zoos ont une préoccupation pour la biodiversité plus élevée que l'échantillon de non-visiteurs de zoos, et que des visites répétées au zoo renforcent ces préoccupations, par le biais du sentiment de connexion à la nature. A l'inverse, les préoccupations pour la biodiversité ne semblent pas influencées par le sentiment de connexion à la nature pour les usagers de parcs urbains. Une visite au zoo seule ne suffit pas à modifier la connexion à la nature ou les préoccupations, mais des visites répétées au zoo auraient donc un impact positif, en comparaison à une visite dans un parc urbain, pour la prise en compte des enjeux de conservation.

6. Enfin, dans l'article « Préférences du public pour la conservation des espèces : le charisme l'emporte sur le statut de menace » (soumis à *Biological Conservation*), nous montrons à travers l'analyse des données de participation à un programme de parrainage

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d'animal au zoo et d'un questionnaire soumis aux participants, que les personnes participant à un tel programme choisissent davantage des espèces charismatiques que des espèces menacées, mais qu'en moyenne, les personnes ayant choisi des espèces moins charismatiques ont donné plus d'argent au programme que les personnes ayant choisi les espèces plus charismatiques. Nous montrons ainsi que les participants à un tel programme s'appuient plus sur des critères émotionnels (par ex. le charisme) que biologiques (par ex. le statut de menace). Nous soulevons donc la question de l'efficacité d'un tel programme pour la reconnexion des citoyens aux enjeux de conservation.

Les recherches présentées dans cette thèse sont interdisciplinaires dans les méthodologies et concepts employés, empruntant à la psychologie de la conservation, la psychologie sociale, l'anthropologie, la psychoacoustique et l'économie environnementale. Cette thèse de doctorat est cependant avant tout ancrée plus globalement dans le domaine des *sciences de la conservation*.

Ce travail de thèse nous a donc permis de mettre en avant que les expériences de nature ont évolué au cours des dernières décennies, et ne sont plus simplement en train de disparaître. C'est pourquoi il est important de reconnecter les citoyens avec la nature, en favoriser la volonté et les opportunités d'aller dans la nature, sans pour autant essayer de restaurer les expériences de nature qui existaient auparavant. Cela nécessite donc de mieux comprendre ces expériences de nature, avant de les promouvoir, en donnant aux individus et aux groupes sociaux des opportunités d'expérience de nature dans leur diversité et leur complexité dynamique, et en éduquant les individus sur la nature et les moyens d'en faire l'expérience. J'ai ainsi pu explorer le potentiel des zoos à fournir de telles expériences de nature, notamment du fait que la visite au zoo permet des expériences sociales et l'éducation à la conservation pour un large public.

Ce travail a également montré que même si une ou plusieurs visites au zoo ne pouvaient être causalement liées avec le sentiment de connexion à la nature, le zoo semble être

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considéré comme un espace de nature, par des personnes enquêtées au zoo et hors des zoos. De plus, nous avons mis en avant l'aspect restaurateur de la visite au zoo, majoritairement par le biais du sentiment d'évasion de la routine urbaine quotidienne. L'*oasis* de nature que procure le zoo dans le contexte urbain permettrait aux visiteurs de s'évader de leurs vies quotidiennes. Ainsi, alors que l'expérience de visite au zoo ne semble pas affecter le sentiment de connexion envers le monde naturel, elle constitue tout de même une expérience de nature pour les citoyens. Par ailleurs, l'exotisme montré au zoo semble jouer le rôle de médiateur de l'expérience quotidienne de nature, facilitant la perception de la biodiversité urbaine par les visiteurs. Les zoos ont donc un rôle important à jouer dans la reconnexion des citoyens à la nature locale, même s'ils mettent davantage l'accent sur les espèces exotiques. Même si les zoos semblent dédiés aux enfants, avec une importante composante de transmission de l'expérience, ils ont des implications pour des adultes aussi bien que pour les enfants. En effet, ils peuvent contribuer à la construction de l'identité environnementale chez les enfants, mais aussi procurer des expériences de nature aux adultes, qu'elles soient sociales ou individuelles, et accroître leur connaissance générale et leurs orientations envers le monde naturel.

Avec la crise actuelle de biodiversité, il est également essentiel de reconnecter les individus avec les enjeux de conservation. Les zoos peuvent jouer un rôle important dans l'éducation du public à la conservation, mais leur réel impact sur les attitudes et comportements envers la conservation reste incertain. Nous avons montré au travers de cette thèse de doctorat qu'une simple visite au zoo n'est pas suffisante pour augmenter les attitudes pro-conservation, mais que la répétition de ces expériences pourrait être bénéfique pour de plus fortes préoccupations pour la biodiversité. Par ailleurs, en comparaison avec une expérience de visite d'un parc urbain, la visite au zoo pourrait être une amorce vers les attitudes pro-conservation, via le sentiment de connexion à la nature. Des visites au zoo pourraient donc avoir des effets bénéfiques sur les attitudes pro-conservation, selon le sentiment individuel de connexion à la nature, et les attentes que la personne a vis-à-vis de la visite. Cependant, à l'inverse des attitudes pro-conservation, nos résultats sur l'étude menée auprès des « parrains » d'animal au zoo suggèrent que le zoo, via les programmes de conservation, ne

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serait pas efficace pour promouvoir les comportements pro-conservation en lien avec les espèces menacées.

Par conséquent, il reste incertain que des visites au zoo pourraient affecter la connexion à la nature, et, même si les zoos peuvent renforcer la perception de séparation Homme-Nature, la visite au zoo semble néanmoins constituer une expérience de nature qui pourrait être bénéfique pour les citoyens sur de multiples aspects, que ce soit au niveau individuel (e.g. restauration et cohésion sociale) et au niveau des enjeux de conservation (e.g. identité sociale liée à la conservation, reconnexion à la biodiversité urbaine, connaissance sur la conservation et attitudes pro-conservation). Pour conclure, ce travail de thèse a mis en avant que dans le processus de reconnexion des individus à la nature et aux enjeux de conservation, les zoos procurent indubitablement un type d'expérience de nature aux citoyens, qu'il convient de considérer, au même titre que d'autres types d'expériences de nature, e.g. dans les forêts, particulièrement du fait que les zoos sont des institutions qui accueillent une très large et diverse proportion de la population, partout dans le monde.