



Année 2014

MUSEUM NATIONAL D'HISTOIRE NATURELLE
ECOLE DOCTORALE « SCIENCES DE LA NATURE ET DE L'HOMME »
(ED 227)

N° attribué par la Bibliothèque

□□□□□□□□□□□□□□□□

THESE

Pour obtenir le grade de

DOCTEUR DU MUSEUM NATIONAL D'HISTOIRE NATURELLE

Discipline : **ECOLOGIE**

Présentée et soutenue publiquement par

Zina SKANDRANI

Le 15 Septembre 2014

Gouvernance de la biodiversité en milieux anthropiques : De l'intégration des conceptions de la nature à la considération des dynamiques socio-écologiques

Biodiversity governance in anthropic habitats: From integrating nature conceptions to considering social-ecological dynamics

JURY

Couvet Denis	Professeur, Muséum National d'Histoire Naturelle	Président du jury
Frascaria Nathalie	Professeur, AgroParisTech	Rapporteur
Draus Paul	Professeur, Université du Michigan (USA)	Rapporteur
Chlous Frédérique	Professeur, Muséum National d'Histoire Naturelle	Examinatrice
Qureshi Salman	Professeur, Université de Bayreuth/ Humboldt Université Berlin (Allemagne)	Examineur
Prévot Anne-Caroline	Chercheur CNRS - Muséum National d'Histoire Naturelle	Directrice de thèse

RESUME

Cette thèse de doctorat propose des réflexions théoriques sur la gestion de conflits autour de la conservation et de la gouvernance de la biodiversité dans des lieux jusque récemment exclusivement pensés pour les humains. L'objectif général de mon travail a été de souligner dans quelle mesure les représentations de la nature peuvent entraver des efforts de conservation et à travers quels processus socio-écologiques ces dernières sont établies. Plus précisément, j'ai étudié les interactions réciproques entre représentations sociales de la biodiversité et dynamiques socio-écologiques, ou comment certaines conceptions sur la biodiversité sont activement produites et véhiculées par des dynamiques d'interactions entre les composantes humaines et non-humaines de la nature. De plus, j'ai montré dans quelle mesure ces conceptions peuvent être à l'origine de réticences sur des sujets environnementaux, en particulier quand de nouvelles conceptions impliquent des redéfinitions de l'espace et des relations humains-biodiversité-environnement.

Ces réflexions théoriques s'appuient sur des travaux empiriques de recherche en milieu urbain. Ici, j'ai considéré les écosystèmes urbains comme des socio-écosystèmes composés de dynamiques sociales, politiques/institutionnelles et écologiques interconnectées. En cela, ces études s'inspirent de cadres d'analyse des systèmes socio-écologiques (Ostrom 2009), de la théorie de la résilience (Folke 2006), de la théorie de l'acteur-réseau (Latour 1994) et de la théorie des représentations sociales (Moscovici 2000). Excepté pour un cas, les recherches menées prennent les pigeons urbains (*Columba livia*) comme modèle d'analyse. Le pigeon urbain a en effet ceci de particulier qu'il n'a jamais existé 'à l'état sauvage' et a toujours eu son habitat 'naturel' parmi les humains (Johnston et Janiga 1995). En tant qu'animaux domestiqués, les pigeons ont été dotés de valeurs symboliques (d'amour, paix et fertilité) sur la base de leurs caractéristiques visibles (et désirées) (Jerolmack 2008). Alors qu'ils ont été « créés » par les humains pour un usage domestique, ils se sont ensuite échappés puis ré-ensauvagés (ou 'féralisés'), et constituent ainsi ce qui pourrait être appelé un 'hybride' (*sensu* Latour), un produit de la nature et de la société, et même un double hybride (Jerolmack 2007).

L'espèce est ainsi particulièrement intéressante dans ce travail, puisqu'il ne s'agit pas 'juste' d'un objet naturel mais d'un bon exemple à travers lequel la production socio-écologique de sens peut être étudiée.

Le travail de thèse est présenté sous la forme de 5 articles ou manuscrits, suivant le cheminement suivant :

1. La présence de la biodiversité en ville précède et conditionne sa problématisation ; elle constitue en cela un élément central à partir duquel les représentations de la biodiversité vont ensuite se développer. Cette présence n'est cependant pas fortuite. Ainsi, dans le premier article intitulé « Tolérance environnementale chez les oiseaux urbains : adaptation synanthropique ou plasticité phénotypique? », mes collègues et moi soulignons dans une perspective écologique, la « agency » des pigeons dans leur installation dans les espaces anthropiques. En étudiant la tolérance environnementale des pigeons, nous démontrons que ceux-ci tirent avantage de leurs propres caractéristiques au même degré que des particularités urbaines pour persister dans les villes.

2. Dans l'article « Espèces nuisibles : par-delà de la perspective écologique », nous utilisons le concept d' « espèces nuisibles » et les changements dans les images des pigeons pour démontrer que les représentations de la nature et de la biodiversité sont produites par des processus historiques et d'interactions inter-espèces, avec de multiples facteurs d'influence, d'« agences » et d'enjeux. Nous montrons en outre comment l'évolution de ces conceptions ou « socio-natures » (Swyngedouw 2004) sont au cœur de conflits contemporains au sujet des pigeons urbains dans de nombreuses métropoles.

3. Dans l'article « Ancrer le 'paradoxe du pigeon' : médiation des interactions avec la biodiversité ordinaire par le contexte public », nous illustrons ensuite, à travers une étude comportementale, les oppositions entre d'une part les encouragements officiels croissants pour une reconnexion avec la nature afin de renforcer la conscience environnementale, et d'autre part

l'influence restrictive du contexte social normatif sur les interactions entre les humains et la nature urbaine au quotidien.

4. Dans l'article « Verdir la ville et ensuite ? Orientations similaires mais politiques publiques divergentes dans deux capitales européennes » nous nous détachons de l'exemple des pigeons urbains pour mettre en évidence, par une comparaison entre Paris et Berlin, comment différents discours institutionnels peuvent façonner les représentations de la nature : encouragement explicite de la restauration de la nature ou définition implicite des relations humains-nature à travers l'aménagement et la gestion des parcs urbains. Nous suggérons que des discours explicites et implicites contradictoires peuvent bloquer l'acceptation sociale de mesures institutionnelles de conservation en milieu urbain.

5. Enfin, dans l'article de conclusion « Modélisation d'un système socio-écologique urbain : vers une coexistence des citadins et des pigeons en ville », nous posons la question de la gestion et du contrôle des pigeons urbains et fournissons un exemple concret de médiation et de gouvernance intégrative dans un conflit social autour de la biodiversité urbaine, construit à partir des perceptions sur les pigeons et des facteurs d'influence sociaux et écologiques.

SUMMARY

The present Ph.D. thesis strives to offer theoretical stimuli for handling social conflicts on biodiversity and for governance models engaged in democratic environmental conservation and the creation of spaces for nature and non-human species, in places exclusively designed for humans until recently. The general purpose of the current work is to highlight to what extent nature conceptions might impede conservation aims and through which social-ecological processes they may arise. In particular, I intend to empirically expose how conceptions about the environment and biodiversity are actively produced and spread through the manifold interaction dynamics between nature's human and non-human components. Further, I elucidate how the resulting spheres of meaning may unknowingly generate understanding gaps and reluctance on environmental issues, particularly when changing nature representations entail landscape redefinitions, resulting in new human-biodiversity-environment relations and spatial ascriptions.

I have illustrated these hypotheses in five articles and manuscripts addressing urban areas as a crucial place for confronting socio-environmental problems. The studies constituting the Ph.D. thesis consider urban ecosystems as social-ecological systems made of reciprocal influence dynamics among social, political/institutional and ecological variables. In this, they take inputs from theoretical frameworks for the analysis of social-ecological systems (Ostrom 2009), resilience theory (Folke 2006), actor-network theory (Latour 1994) and the theory of social representations (Moscovici 2000). Except for one study, the research uses urban pigeons (*Columba livia*) as a model to analyze socio-environmental interactions. This particular type of pigeon never existed 'in the wild' and always had his 'natural habitat' among humans (Johnston and Janiga 1995). As domesticated animals, pigeons came to be endowed with symbolic meanings (of love, peace, and fertility) based on their perceived (and desirable) traits (Jerolmack 2008). Although they were utilized by humans for domestic use, they then escaped to become feral and are thus what could be called a 'hybrid' (*sensu* Latour 1993), a product of nature and society; they may even be considered a double hybrid (Jerolmack 2007). The

species is thus particularly interesting for the purpose of this work, as it is not ‘just’ a natural object with an essential meaning but a good example on which social-ecological meaning production can be investigated.

1. Biodiversity’s presence in the city precedes and conditions its problematization and is a central element from which its representations will further develop and depend. However, this presence is not fortuitous. Thus in the first manuscript entitled “Environmental tolerance in urban Birds: synanthropic adaptation or phenotypic plasticity?” my colleagues and I highlighted pigeons’ agency in settling in anthropic areas from an ecological perspective. By investigating pigeons’ environmental tolerance, we demonstrated that they take advantage of their own characteristics to the same degree as of urban features to persist in cities.

2. In the article “Nuisance species: beyond the ecological perspective” we used the concept of ‘nuisance species’ and changes in pigeons’ images to demonstrate that nature and biodiversity representations are produced out of historical processes and interspecies interactions, with multiple influence factors, agencies and issues at stake. We further showed how the evolution of these conceptions or ‘socio-natures’ (Swyngedouw 2004) is at the heart of current conflicts with urban pigeons in many cities.

3. In the manuscript “Anchoring the ‘pigeon paradox’: how public context mediates interactions with ordinary biodiversity” we highlighted, using a behavioral study, discrepancies between increasing official support for nature reconnection to strengthen people’s environmental awareness and the restrictive influence of everyday normative social contexts on human-urban nature interactions.

4. In the manuscript “Greening the city, and beyond? Similar orientations but contrasted local policies in two European capitals” we move beyond the example of urban pigeons, and evidence in a comparison between Paris and Berlin, different institutional discourses that shape nature representations, from an explicit nature restoration advertisement to an implicit definition of human-nature relations in public urban park management. We suggest that mismatched explicit-

implicit discourses may thwart institutional endeavors and hinder social acceptance of conservation measures in urban settings.

5. In the concluding manuscript “Modeling an urban social ecological system: towards coexistence between people and pigeons in the city” we addressed urban pigeon management and control and provided a concrete example of mediation and integrative governance in a social conflict on urban biodiversity, built by focusing on pigeon perceptions and their social and ecological influence factors.

ACKNOWLEDGEMENTS

Undertaking this Ph.D. thesis was a truly enjoyable experience, not at least thanks to the numerous persons I had the pleasure to meet and interact with in these three years.

But first I have to thank the pigeons, for sharing our common space and offering me a uniquely inspiring study subject. It must have been destiny to end up with a Ph.D thesis on this subject, as I remember protesting in a discussion almost 10 years ago: Too much pigeons?! Based on what criteria? Defined by whom?

To this subject brought me my esteemed supervisor Anne-Caroline Prévot. If there is some merit to this work, it has to be shared with her, while responsibility for defaults remains (most probably) mine. I am deeply indebted to her for standing up for me energetically and repeatedly from the very beginning we met and aspired to work together. I would like to thank her for her awesome way to guide me through my PhD., for the independence she always gave me, allowing me thus to mature in my research, for her availability and precious advices whenever I was stuck, and for her patience when I could (sometimes, but very rarely) be unreceptive to suggestions, until I would come to reason by myself. I was confident to find in her the right supervisor for me, but I would never have expected to be that lucky.

This thesis is the outcome of a collaborative work and diverse inputs from many people, from which I would like to acknowledge especially N. Emilio Baldaccini for the generous opportunities he offered me to carry out research in Pisa and Sardinia, Julien Gasparini for boosting my work with his incomparable way to be critical and constructive at once, Marion Desquilbet for her guidance and coaching in an enterprise Anne-Caroline and I could not have done without her and which resulted in my favourite manuscript, Assaf Shwartz for having always a good advice, all the members of the

Centre d'Ecologie et des Sciences de la Conservation (CESCO) for helpful exchanges and providing such a pleasant working environment, Nancy Katumua and Sabine Normand for their precious administrative assistance, and Alberto Hernandez Salinas for stimulating me through our discussions like no one else and pushing me continuously to better define my thoughts and positions.

I would like to thank the members of the Jury, Nathalie Frascaria, Paul Draus, Frédérique Chlous, Salman Qureshi and Denis Couvet, that agreed to evaluate this work and participate in my thesis viva.

Finally I would like to thank my family, Raja, Renate and Sara Skandrani as well as Leonardo Colasanti, for their supportive love in each of my undertakings. I am especially grateful to my parents, for the calm and relief they offered me at the (maybe less enjoyable) end of the thesis, and more generally for granting my curiosity and drive for interaction with animals to unfold from an early age, in such a way that this special connection became literally a family tradition.

To my grandmothers Marie and Cherifa, who regardless of their different geographical and social backgrounds, did not have the opportunity to go beyond elementary education.

To my beloved animal friends I grew up with, which opened my eyes and broadened my mind.

TABLE OF CONTENTS

RESUME.....	ii
SUMMARY.....	v
ACKNOWLEDGEMENTS.....	viii
TABLE OF CONTENTS.....	xi
GENERAL INTRODUCTION.....	1
CHAPTER 1	<i>ENVIRONMENTAL TOLERANCE IN URBAN BIRDS: SYNANTHROPIC ADAPTATION OR PHENOTYPIC PLASTICITY?</i>
Chapter Introduction	12
Manuscript	16
CHAPTER 2	<i>NUISANCE SPECIES: BEYOND THE ECOLOGICAL PERSPECTIVE</i>
Chapter Introduction	39
Manuscript	42
CHAPTER 3	<i>ANCHORING THE ‘PIGEON PARADOX’: HOW PUBLIC CONTEXT MEDIATES INTERACTIONS WITH ORDINARY BIODIVERSITY</i>
	<i>GREENING THE CITY, AND BEYOND? SIMILAR ORIENTATIONS BUT CONTRASTED LOCAL POLICIES IN TWO EUROPEAN CAPITALS</i>
Chapter Introduction	74
Manuscript 1	78
Manuscript 2	95
CHAPTER 4	<i>MODELING AN URBAN SOCIAL ECOLOGICAL SYSTEM: TOWARDS COEXISTENCE BETWEEN PEOPLE AND PIGEONS IN THE CITY</i>
Chapter Introduction	118
Manuscript	120
CONCLUSION.....	145
RESUME VERSION LONGUE.....	148
REFERENCES.....	167
APPENDICES.....	174

GENERAL INTRODUCTION

The term “nature” encompasses two clusters of ideas (Gandy 2006). On the one hand, it relates to biotic and abiotic environmental features, ranging from organisms (plants, non-human animals, humans) to green infrastructures such as gardens, parks, reserves or ecosystems, including geologic settings, climate, species pools, hydrologic processes, and other biological or geophysical factors (Grimm et al. 2000). On the other hand, the term “nature” refers to the human interpretations of these biogeophysical patterns (Gandy 2006). Cross-cultural comparisons have revealed the absence of any commonality in people’s representations of that reality (Griffiths and Poulter 2000). In practice, both concrete and abstract elements are often interwoven to the extent that discourses and different understandings of nature are mobilized and contribute to the material production of environments (Swyngedouw 1999). Further, they are reciprocally influenced by biogeophysical forces and ecosystem dynamics (Grimm et al. 2000). “Nature” and environments are hence socio-physical constructions: both the constructed environment as well as land-use changes, urban parks, natural reserves, consumption of resources, introduction or domestication of species, etc. are the outcome of historical processes constituted through both biophysical environmental features and socio-cultural content about these elements (Haraway 1991).

Representations of nature and the ensuing definition of landscapes further determine the conceptual placing of species (including humans) within and in relation to these environments. They also influence the ordering of species in relation to each other (Brownlow 2000). For instance, the inclusion or exclusion of particular animal species and their treatment with affection or disgust has in many past and present societies depended on their placement within a particular cosmology (Griffiths and Poulter 2000). Similarly, scientific schemes for the interpretation of nature, such as the ecological concept of ‘ecological niche’, delineate an organism’s distinctive place within biological classifications and a proper place in worldly environments (Philo and Wilbert 2000).

The human relationship with nature, as it has been culturally mediated in the Western dominant social paradigm (Dunlap and Van Liere 1974), has predominantly been defined based on conceptions of a firm boundary between humanity and the environment. Latour (1993) argues that

the essence of the “modern constitution” lies in the fiction of an ontological separation between humans and society on one side and nature and non-humans on the other side. This dualism has been explained to be deeply rooted in Western tradition and inherited from Greek philosophy and Judeo-Christian theology (White 1967). Since the seventeenth century, rationalists such as Descartes and Bacon, as well as Enlightenment thinkers such as Newton, Kant, Adam Smith, and Montesquieu further contributed to anchoring the externality of nature and the disjuncture of nature and human society (Heynen 2006). In nineteenth century materialist evolutionism, ‘man’ sought to transcend nature and separate himself from it as a means to controlling the ‘external’ world (Jones 2000).

Seeing nature as distinct from humans has disseminated into a myriad of further conceptual categorizations and framed the treatment of the environment and the spatial ordering of its biodiversity components. For example, the externalization of “nature” from human beings has made it easier to consider “nature” as a resource to be overexploited and refined for social and economic growth in western societies (Gustafsson 2013, Smith 2006). Further, the conceptual ‘othering’ of non-humans such as animals has often led to a geographical ‘othering’, thus designating them in spaces different from those designated for human habitation (Jerolmack 2008, Philo and Wilbert 2000). Anthropization of landscapes meant the active *displacement* and *re-placement* of local species that should properly be proximate to people (Brownlow 2000): pets and companion animals under human dominion are envisaged in zones of human settlements; wild species in the wilderness beyond human civilization or in zoos where their lack of adaptation to humans is compensated by their confinement behind bars. Between these two extremes, domesticated animals that are useful to humans as food and other products are allocated to specialized locations such as agricultural landscapes (‘the countryside’, Philo and Wilbert 2000, Philo and Wolch 1998). In parallel, the modern city as a typical human habitat has been perceived as a deviation from a presupposed ‘natural’ environment (Gandy 2006). The concepts of ‘urban’ and ‘city’ have been contrasted with their inverses of ‘rural’ and ‘country’ as an effect of the society-nature antinomy (Robbins 2007).

However, these established conceptions about nature and society-environment relations have been increasingly debated and reformed in the last decades through developments in epistemology and scientific research as well as in political circumstances (e.g., Millennium Ecosystem Assessment) and at the concrete level of urban nature management (Heynen 2006, Wolch et al. 2000). From a theoretical perspective, the traditional representation of the 'civilized' city has evolved into a more holistic conceptualization of nature as embedded within the urban concept (or the city as part of nature, Campbell 2010).

Contemporary scholars further emphasize that natural conditions are not separate from social processes. Hence, Berkes and Folke (1998) used the term "social-ecological system" to highlight the integrated concept of humans within nature and to address the delineation between social and ecological systems as artificial and arbitrary. Classical ecology and traditional earth science-based approaches of ecosystem dynamics that treated humans as external to the system have been judged as obsolete (Campbell 2010, Grimm et al. 2000) and challenged by novel frameworks. For example, resilience theory includes humans as agents of environmental change and highlights the feedback between ecosystem development and social dynamics, as well as their cross-scale interactions (Folke 2006).

These conceptual developments are driven by the dramatic and recognized consequences of human population growth and drastic urbanization on environmental degradation, biodiversity loss and the potential extinction of thousands of additional species (Dunn et al. 2006, Young et al. 2006, Heynen 2006). In parallel, natural reserves, an effect of the 'humans out' vision (Maffi and Woodley 2010), are recognized as insufficient for environmental conservation (Miller and Hobbs 2002). However, to effectively rediscuss environmental management, humans' own boundaries had necessarily to be rediscussed. Thinking of nature and human-environment interdependencies in these novel terms indeed involved a fundamental reconsideration and reorganization of the physical and imagined landscapes, as well as a redefinition of the proper relations between nature and its human and non-human components (Brownlow 2000). Human spaces are hence increasingly considered and

advocated as complexes of nature restoration and ecological diversity (Dunn et al. 2006, Rosenzweig 2003). In this new vision, biodiversity elements are considered as urban residents (Gandy 2006), with the acknowledgement that urban ecosystems maintain a cosmopolitan mix of species. Among these species, e.g., remnant species from pre-urban habitats or naturalized species (non-native, forming sustainable populations without direct human help but not necessarily spreading, Rejmànek 2000), some respond well to urban conditions and experience substantial range expansion and population growth, whereas others (termed 'synurbic') associate with urban areas to a greater extent than with other ecosystems (Francis and Chadwick 2012).

Beyond the modification of external circumstances, emphasis is further placed on the necessity of Western societies to lift people's estrangement from nature and to enhance individual connections with their environment by encouraging direct experiences with urban nature (Dunn et al. 2006, Miller 2005). As an adaptive response to the ongoing global ecological crisis, the recognition of the continuum between nature and society and the change in conceptualizing human-environment relations thus entails a progressive revision of values and an adjustment in societies' lifestyles (Maris and Béchet 2010). Urban areas, with their much larger human populations than rural areas, represent the sites where these transformations and ensuing socio-environmental issues are experienced most acutely (Heynen 2006).

Using resilience theory as an overarching framework, such conceptual developments and transformations in the understanding of nature could be conceived as internal disturbances in the social-ecological system that may generate traps and breakpoints in the resilience of the system and trigger a number of reactions and dynamics across spatial and temporal scales, eventually leading to what may be perceived as a "crisis" (Young et al. 2006). Indeed, the shift in mental models toward humans-in-the-environment perspectives and the resulting changes in urban landscape description and meaning are not necessarily embraced uniformly. Unconscious binary thinking persists in our everyday lives when trying to get far from the city and escape to nature during vacations, and thus constantly up-dating such oppositions (Robbins 2007). As a consequence, there is presently an

overlapping and increased diversity in the way people represent and value nature, which may come into conflict in different ways when dealing with environmental issues (Maris and Béchet 2010).

First, urban residents are less familiar with biodiversity than are their counterparts of 25–30 years ago (Ditchkoff et al. 2006) and sometimes hold low tolerance for nature due to the loss of everyday interactions with nature (Jerolmack 2008). They have instead been forced over time, in the absence of animals and natural elements in the city, to rely on images relayed by various media (e.g., zoos, books, television, and film) of these non-human ‘others’ as ‘wild’ and view them as distinct from humans (Brownlow 2000). Untamed nature and especially animals are thus still experienced by many people as ‘out of place’, social disorder (Douglas 1966), and transgressive in human places (Skandrani et al. 2014, Jerolmack 2008). Such remnant perspectives inevitably collide with institutional efforts of urban nature restoration, which results in increased human-biodiversity encounters. For example, in rural areas, social conflicts with wolves have been reported not to be based on antagonistic attitudes about the species itself but on conceptions of the wolf as a fundamentally wild animal acceptable in wilderness areas but not in rural areas (Figari and Skogen 2011). In the context of environmental conservation also, divergent conceptions lead to complex interactions between various stakeholders (Buijs et al. 2011). Indeed, despite a shared ultimate goal (of conserving biodiversity), individual representations proceed from a utilitarian valorization of nature, a tribute of the former human-nature dichotomy, to a more holistic perspective including the non-instrumental, intrinsic value of species, ecosystems, or ecological processes themselves that should not be reduced to a mere means to satisfy human ends (Maris and Béchet 2010). In the first perspective, there may be an economic valuation of biodiversity leading to speak up for the preservation of plant genetic diversity because of its pharmaceutical value (Bonalume and Dickson 1999). By contrast, the latter perspective may further diverge into ecocentric and biocentric values that focus on holistic concepts such as habitats or species and on the individual well being of plants and animals, respectively (Buijs et al. 2011). People are not necessarily consciously aware of their nature representations; however these undergird position and attitude toward conservation issues (Buijs and Elands 2013). Thus, although

the protection of nature, landscapes, and biodiversity is an important issue in public opinion, there can be fierce local resistance to the implementation of environmental policies, as coexisting discourses about nature may yield conflicting protection actions for different types of biodiversity (Gustafsson 2013, Buijs and Elands 2013).

A major challenge today is thus to develop governance models that make it possible to handle such types of complex conceptual change and resolve socio-environmental conflicts or contradictions in a fashion that secures a systems' capacity to support appeased social-ecological relationships into the future (Folke 2006). In keeping with a restoration and conservation paradigm, a further challenge is to manage transitions toward new, more desirable configurations such as social-ecological convivence and to build incentives for collective action and support toward more sustainable development paths. Institutional and conservation efforts of bringing nature back 'in' presuppose the existence of a 'place', which is not only a material place but also a conceptual space where nature is welcome (Brownlow 2000). The definition of this place strongly depends on the main coexisting conceptions about nature, their corollary values and spatial ordering; a mismatch between these lies at the heart of social conflicts about biodiversity (Maris and Béchet 2010). To elaborate on adaptive governance models, research priorities must pay attention to the centrality of nature conceptions and values at stake (Maris and Béchet 2010), which are represented by the interdependent cognitive and normative dimensions of social representations, respectively (Keulartz et al. 2004). Frameworks of social-ecological system analysis have previously recommended the identification of dynamics between social and ecological variables at multiple levels (Ostrom 2009); for example, adaptive management (Holling 1978) has considered key relationships among the components of the socio-ecological system to be managed for the formulation of hypotheses and models. However, nature representations are rarely questioned in these frameworks. In line with environmental pragmatism (Minteer and Collins 2005), adjustive management (Maris and Béchet 2010) and others (Buijs and Elands 2013), we thus argue that when dealing with contradictions and oppositions on environmental and conservation measures, governance models need to clarify the underlying, more

general nature conceptions as well as those who understand biodiversity. In the aforementioned social conflicts regarding wolves, effective mitigation would mean addressing issues of rurality, wilderness and rewilding (Figari and Skogen 2011).

In addition, we further propose relying on social representations theory to highlight not only the content of environmental conceptions but also how they come about, and to critically analyze the discourses shaping their articulation (Moscovici 2000). Uncovering the processes of their production and the ways they are conveyed is central to anticipate the generation of potential conflicting nature understandings and obstacles to conservation in the future. These representations, as well as of the appropriate society-environment relations, are the contextual and socially developed interpretations of the environment, which are relative to a certain place and time (Buijs et al. 2011). They are developed through communication in many different social practices and are related to knowledge, education, and the social groups in which people participate (Moscovici 2000). Exploring these processes involves all society members and concerned stakeholders as well as the interdisciplinary consideration of their interactive dynamics and reciprocal influences (Gobster et al. 2007), through which meaning is assigned to the environment (Mugerauer 2010). Following actor network theory (Latour 1993), both human and non-humans are enrolled and hold agency in this meaning production: lay people, institutions, but also nature and biodiversity. Indeed, biodiversity representations are contingent on institutions and their codifying power (Herda-Rapp and Goedecke 2005, Grimm et al. 2000). These institutions are themselves constantly redefined and reinvented to coevolve with a dynamic environment, as shown by the transition from 'government' to 'governance' taking place in many countries (Duit et al. 2010). Most importantly, plant and animal species are not only a product but essential actors, or 'actants' (Latour 1993), of the social-ecological system, by impacting behaviors and forcing adaptations or adjustments not only at the level of individuals but also at the level of whole municipal economies (Robbins 2007).

We believe that improving our knowledge on the joint construction of nature/biodiversity/animal conceptions and nature-society relations could be a powerful tool to build shared visions and mitigate resistance on environmental and conservation issues.

Thesis Objectives and Structure

The present Ph.D. thesis strives to offer theoretical stimuli for handling social conflicts on biodiversity and for governance models engaged in democratic environmental conservation and the creation of spaces for nature and non-human species, in places exclusively designed for humans until recently. The general purpose of the current work is to highlight to what extent nature conceptions might impede conservation aims and through which social-ecological processes they may arise. In particular, I intend to empirically expose how conceptions about the environment and biodiversity are actively produced and spread through the manifold interaction dynamics between nature's human and non-human components. Further, I elucidate how the resulting spheres of meaning may unknowingly generate understanding gaps and reluctance on environmental issues, particularly when changing nature representations entail landscape redefinitions, resulting in new human-biodiversity-environment relations and spatial ascriptions.

I have illustrated these hypotheses in five articles and manuscripts addressing urban areas as a crucial place for confronting socio-environmental problems. The studies constituting the Ph.D. thesis consider urban ecosystems as social-ecological systems made of reciprocal influence dynamics among social, political/institutional and ecological variables. In this, they take inputs from theoretical frameworks for the analysis of social-ecological systems (Ostrom 2009), resilience theory (Folke 2006), actor-network theory (Latour 1994) and the theory of social representations (Moscovici 2000). Except for one study, the research uses urban pigeons (*Columba livia*) as a model to analyze socio-environmental interactions. This particular type of pigeon never existed 'in the wild' and always had his 'natural habitat' among humans (Johnston and Janiga 1995). As domesticated animals, pigeons came to be endowed with symbolic meanings (of love, peace, and fertility) based on their perceived

(and desirable) traits (Jerolmack 2008). Although they were utilized by humans for domestic use, they then escaped to become feral and are thus what could be called a ‘hybrid’ (*sensu* Latour 1993), a product of nature and society; they may even be considered a double hybrid (Jerolmack 2007). The species is thus particularly interesting for the purpose of this work, as it is not ‘just’ a natural object with an essential meaning but a good example on which social-ecological meaning production can be investigated.

Biodiversity’s presence in the city precedes and conditions its problematization and is a central element from which its representations will further develop and depend. However, this presence is not fortuitous. Thus in the first manuscript entitled **“Environmental tolerance in urban Birds: synanthropic adaptation or phenotypic plasticity?”** (Under review in *Behavioral Ecology*) my colleagues and I highlighted pigeons’ agency in settling in anthropic areas from an ecological perspective. By investigating pigeons’ environmental tolerance, we demonstrated that they take advantage of their own characteristics to the same degree as of urban features to persist in cities.

In the second article **“Nuisance species: beyond the ecological perspective”** (*Ecological Processes* 2014, 3(3):1-12) we used the concept of ‘nuisance species’ and changes in pigeons’ images to demonstrate that nature and biodiversity representations are produced out of historical processes and interspecies interactions, with multiple influence factors, agencies and issues at stake. We further showed how the evolution of these conceptions or ‘socio-natures’ (Swyngedouw 2004) is at the heart of current conflicts with urban pigeons in many cities.

In the third manuscript **“Anchoring the ‘pigeon paradox’: how public context mediates interactions with ordinary biodiversity”** (Under review in *Human Ecology*) we further highlighted, using a behavioral study, discrepancies between increasing official support for nature reconnection to strengthen people’s environmental awareness and the restrictive influence of everyday normative social contexts on human-urban nature interactions.

In the fourth manuscript **“Greening the city, and beyond? Similar orientations but contrasted local policies in two European capitals”** (Under review in *BioScience*) we move beyond the example

of urban pigeons, and evidence in a comparison between Paris and Berlin, different institutional discourses that shape nature representations, from an explicit nature restoration advertisement to an implicit definition of human-nature relations in public urban park management. We suggest that mismatched explicit-implicit discourses may thwart institutional endeavors and hinder social acceptance of conservation measures in urban settings.

In the concluding manuscript **“Modeling an urban social ecological system: towards coexistence between people and pigeons in the city”** (Under review in *Environmental Science and Policy*) we addressed urban pigeon management and control and provided a concrete example of mediation and integrative governance in a social conflict on urban biodiversity, built by focusing on pigeon perceptions and their social and ecological influence factors.

The research presented below is inherently interdisciplinary in the employed methodologies, borrowing from ethology, animal geography, social sciences, social psychology and formal modeling. However, the Ph.D. thesis is primarily anchored in the field of ecology. Although it could be further specified into behavioral and human ecology with environmental conservation and governance goals, I wish to emphasize its integration into the field of ecology more generally. Indeed, as I develop another way of thinking of humans in the environment, the next step is to echo these conceptual evolutions in the redefinition of the scientific disciplines themselves. The fundamental conceptual barriers and the exclusionary categories ‘ecological’ and ‘social’ must also be removed at the academic level. With people both affecting and responding to ecosystem processes (Chapin et al. 2010) and the primary importance of human decision-making on ecosystems (Grimm et al. 2000), ecology cannot be further considered as a sphere of non-human organisms and the biogeophysical milieu. This is not only about acknowledging the (de facto) relevance of social research for environmental and conservation issues (Sandbrook et al. 2013, Fazey et al. 2005) but also about coining a new meaning of ecology as an integrative discipline including humans and non-humans equally, that is, all biota in their interconnected communities within geophysical, chemical and climatic contexts (Mugerauer 2010).

CHAPTER 1

Environmental Tolerance in Urban Birds: Synanthropic Adaptation or Phenotypic Plasticity?

CHAPTER INTRODUCTION

Historically considered to be unsuitable for biodiversity, urban ecosystems are now recognized to be used by a wide array of species previously associated with rural landscapes, such as small mammals, birds, and herpetofauna. Classic examples include the rock dove (*Columba livia*) and house sparrow (*Passer domesticus*), but songbirds, squirrels, foxes and other small to medium-sized mammals have also successfully acclimated to urban and suburban areas (Francis and Chadwick 2012). Birds, which are more mobile than mammals and herpetofauna, are increasingly found in urban environments and may be key representatives of urban biodiversity. However, they are encouraged, ignored, or rejected by humans living in cities (Campbell 2010). The understanding of their behavior and life history characteristics is thus necessary to the following understanding of their interactions and co-dependent behavior with city dwellers (Philo and Wilbert 2000). The knowledge of species' vulnerability may help develop strategies to encourage their presence in anthropic areas; further, comprehensive knowledge about the behaviors that are at stake in human-biodiversity conflicts may help to mitigate their effects.

Species in these urban and suburban areas are exposed to a novel set of environmental stresses relative to their rural counterparts and different from the selective pressures under which they evolved. As a consequence, successful urban colonizers often display modified behaviors (Stephen et al. 2006). In this sense, we might think of birds and urban biodiversity not only as an ecological *product* of the city but also, although they are not the prime mover of the urban ecosystem, as an essential part of it (Robbins 2007).

Behavioral modifications may relate to temporal activity patterns, spatial distributions, foraging and reproductive strategies (Francis and Chadwick 2012). As human activity in urban areas is greatest during daylight hours, several species may switch their activity to crepuscular periods or become strictly nocturnal, such as large carnivores and other species that are easily disturbed by humans (Stephen et al. 2006).

As human waste sites and city streets provide substantial amounts of food in the form of trash, urban animal species commonly exhibit a marked increase in their consumption of these items (Prange et al. 2004, Kristan et al. 2004). When nutrition improves, it is common for reproductive rates to increase, often resulting in greater litter sizes, greater survival of offspring, and ultimately greater densities (Robbins 1993). The increased resource availability in San Diego, California has reduced the competition for mates and led to a greater investment in parental care over the longer urban breeding season for urban Dark-eyed Junco (*Junco hyemalis*) populations (Yeh 2004). Blackbirds (*Turdus merula*) have been shown to respond to urban selection pressures such as food limitation by reducing their clutch size and nesting for longer periods (Ibanez-Alamo and Soler 2010); further, males developed gonads earlier to create a longer reproductive season and displayed reduced migratoriness (Partecke and Gwinner 2007). In Magpies (*Pica pica*), nesting behavior (such as nesting height) differed between urban and rural populations (Wang et al. 2008). As the elevated noise associated with urban landscapes (i.e., vehicular traffic, factories) reduces the effective communication distance, reproductive success and other life history parameters could be negatively influenced. In this context, Cooper's hawks (*Accipiter cooperii*) have been shown to vocalize more in urban settings, which could have implications for the strength of pair bonds and mating success (Estes and Mannan 2003), whereas House finches (*Carpodacus mexicanus*) vary their courtship songs in urban areas (Badyaev et al. 2008). Light-vented bulbuls (*Pycnonotus sinensis*) and Monk parakeets (*Myiopsitta monachus*) have developed the ability to construct nests from anthropic materials within urban environments (Wang et al. 2009) and to use anthropic structures such as utility poles for nesting, respectively (Burger and Gochfeld 2009). Finally, urban populations of Torresian crows (*Corvus orru*) exhibit city-specific communal roosting in Brisbane (Australia); this behavior has not been observed in rural populations (Everding and Jones 2006). Other behavioral changes include the reduction of escape distances in urban environments or even the ability, in urban Northern mockingbirds (*Mimus polyglottos*), to recognize human threats down to the level of individual humans and to adjust flight distance accordingly (Levey et al. 2009).

The above examples illustrate the extent to which animal species can modify their behavior in response to human-imprinted landscapes. In the first chapter, we aimed to expand upon these behavioral adaptations to urban environments by understanding the mechanisms underlying these adaptations, and more specifically, asked whether these adaptive responses are the result of microevolution in the urban context or of species' behavioral plasticity. We investigated this question based on the example of environmental tolerance in urban birds. Using the feral pigeon (*Columba livia*) as a model system, we conducted comparative behavioral experiments with four different groups: feral pigeons (free-living and captive) and domestic homer pigeons (free-ranging and captive). We used three different standardized behavioral measures of environmental tolerance: high levels of risk-taking behavior expressed in short flight distance from a potential predator, low thresholds for fear or neophobia and high rates of problem solving.

MANUSCRIPT

**Environmental Tolerance in Urban Birds: Synanthropic Adaptation or
Phenotypic Plasticity?**

Zina Skandrani^{1*}, Dalila Bovet², Julien Gasparini³, Natale E. Baldaccini⁴, Anne-Caroline Prévot¹

Behavioral Ecology (Submitted)

¹ Zina Skandrani, skandrani@mnhn.fr, Anne-Caroline Prévot, acpj@mnhn.fr, Centre d'Ecologie et des Sciences de la Conservation CESCO, UMR 7204 CNRS-MNHN-UPMC, Museum National d'Histoire Naturelle, CP 51, 55 rue Buffon, F-75005,

² Dalila Bovet, dbovet@u-paris10.fr, Laboratoire d'Ethologie et Cognition Comparées, Université Paris Ouest Nanterre La Défense, F-92001

³ Julien Gasparini, jgaspari@snv.jussieu.fr, Institut des d'Ecologie et des Sciences de l'Environnement de Paris, PRES Sorbonne Universités, UPMC Univ Paris 06, F-75005 Paris

⁴ Natale E. Baldaccini, natale.emilio.baldaccini@unipi.it, Dipartimento di Etologia, Ecologia & Evoluzione, Università degli Studi di Pisa, I-56126

* Corresponding author

KEY WORDS: Environmental tolerance; Adaptation; Behavioural plasticity; *Columba livia*; Flight distance; Neophobia; Problem-solving.

I. INTRODUCTION

Ever-increasing urbanization and human domination allows major changes in habitat and natural ecosystems. More, this led to the creation of so-called “novel ecosystems” (Seastedt et al. 2008) where new assemblages of species and their environment are provided. In these systems, natural species must also deal with the presence of humans (Grimm et al. 2000). While numerous species have disappeared in these modified habitats, others have adapted to and even thrive in anthropic environments (Crocini et al. 2008). For instance in birds, these adaptations can take the form of a higher propensity for dispersal, larger breeding ranges, a higher annual fecundity and clutch size, sedentariness (Jokimäki and Suhonen 1998, Chace and Walsh 2006). Urbanized areas being characterized by specific habitats such as lawns, buildings and fragmented shrub, some species that are evolutionarily adapted to cliff-like rocky areas, as the rock dove and peregrine falcon, or to cavity-nesting as the house sparrow, house finch, and European starling species, are therefore pre-adapted through their nesting habits to the concrete edifices of cities or to inhabit human dwellings (McKinney 2002, Møller 2008). These species are often ground-foraging seedeaters or omnivores (McKinney 2002). Generally, urban habitats are often characterized as fragmented and with heterogeneous resources for animals living in there (Goddard et al. 2010, McKinney 2008). In addition, urban environments are characterized by the proximity of humans. Urban species have thus generally a higher environmental and human tolerance than conspecifics living in less urbanized areas (Bonier et al. 2007, Møller 2008).

Recent empirical studies suggest indeed that environmental tolerance provides advantages for animals in heterogeneous habitats, by enabling them to adjust their behaviour when confronted with fluctuating ecological resources, due to naturally occurring events or to human activities that alter their habitat. For instance, these species can learn to forage in close proximity to humans, to adopt novel foraging strategies or to exploit new human-related resources (e.g. scavenging on human refuse, nesting boxes, feeders; Evans et al. 2010), shelters, or habitats (Tomasello & Call, 1997, Day et al. 1999, Sol et al. 2005, Jones 2005, Stephens et al. 2006, Sol et al. 2008). A well-studied example

of environmental tolerant bird that coped with a wide variety of ecological contexts is the blackbird *Turdus merula*, which has progressively settled in urban areas all over the continents (Hagemeijer and Blair 1997), showing very few neophobic responses (Corey, 1977) while highly innovating when preying in Australia on copper skink and lizards, and hawking insects in the evening in cities (Marples et al. 1998).

Most studies related to environmental tolerance propose that environmental tolerant birds adapted to anthropic environments through rapid micro-evolution (“adaptive hypothesis”, Stephen et al. 2006, Møller 2008). This hypothesis is based on the so-called “behavioural drive hypothesis” (Mayr 1963, Wilson 1985), which assumes that behavioural changes in habitat and food selection change the way that animals interact with their environment and influence fitness, selecting for the adaptive individuals (Stirling and Lefebvre 2005, Stephen et al. 2006, Bouchard et al 2007). Based on this hypothesis, the organism’s exposure to novel environments leads to adaptations to these new conditions and to trait divergence from the ancestor in behaviour, physiology, and/or morphology (Price et al. 2003). However, in most studies reporting urbanisation-related divergence in behavioural phenotypes, it remains unclear whether the observed differences are grounded in evolution (Atwell et al 2012), or in phenotypic plasticity i.e. the ability of an organism to express different phenotypes depending on its current or recent environmental conditions (Yeh et al. 2004, Stephen et al. 2006, Slabbekoorn et al. 2006). Clear directional selection in response to anthropogenic pressures have been reported in peppered moths (*Biston betularia*) shifting color morphs in response to industrial pollution (Kettlewell 1961), in urban American Dipper (*Cinclus mexicanus*), which modified bite force and bill morphology in response to differing seed availabilities between urban and rural locations (Badyaev et al. 2008), in cliff swallows whose average wing length declined in response to road accidents (Brown and Brown 2013), and in the dark-eyed junco displaying bolder exploratory behaviour correlated with lower corticosteron levels (Atwell 2012). However, the faster and shorter songs of Great Tits (*Parus Major*) living in cities (Slabbekoorn 2006), or the different frequency of

songs in other bird species, that overcome low frequency background noise (Francis et al. 2012) could be explained either by adaptation or phenotypic plasticity.

In the present study, we aimed to investigate whether the better environmental tolerance in urbanized birds is the expression of 1) phenotypic plasticity or 2) whether it is the result of further adaptation to the urban context which we termed a “synanthropic adaptation”. To do this, we used the feral pigeon (*Columba livia*) as a model system. Indeed, feral pigeons (domestic homers’ descendants, Stringam et al. 2012) are the most highly urbanized bird species in the Western Palearctic (del Hoyo et al. 2005), after the increase of important urban pigeons populations all over Europe and the United States since the mid-20th century (De Planhol 2004). We compared three behaviors of 4 different groups of pigeons (*Columba livia*), differing by their status (feral or domestic) and their rearing conditions (captive or free-ranging). Under the adaptation hypothesis, we predict that feral individuals should have higher environmental tolerance than domestics whatever their environment (captive or free-living). On the opposite, under the phenotypic plasticity hypothesis, we would expect free-living groups (both feral and domestic) to show higher environmental tolerance than captives.

II. METHODS

We examined environmental tolerance in pigeons through three different standardized behaviours:

1. Risk-taking expressed in flight distance from a potential predator like a human individual (Blumstein 2006, Moller 2009),
2. Thresholds for fear or neophobia, i.e., the likelihood to get close to new environmental features (Greenberg and Mettke-Hofmann 2001, Greenberg 2003, Fox and Millam 2004),
3. Rates of problem solving or innovation, i.e. finding an innovative way to acquire food (Webster and Lefebvre 2001, Greenberg 2003, Blumstein 2006, Wright et al. 2010).

II.1.Experimental Protocol

The study took place from April 2012 to May 2013, during the months of April–May, and September–November, excluding the winter season.

Four groups of pigeons were considered (hereafter designed as “treatment”), composed of up to 10 tested-groups of pigeons (hereafter designed as “replicates”, Table 1):

(i) Free-living feral pigeons (7 replicates of 8-35 individuals): they were tested in urban places, in 7 different sites in Paris, France, located at more than 500m from each other: Île de la Cité, 1st district, 1 spot; Île Saint Louis 4th district, 2 spots; Champ de Mars, 7th district, 3 spots; Invalides, 7th district, 1 spot.

The testing sites were chosen regarding the regular presence of birds in these places. Because feral urban pigeons seem to be very faithful to their feeding place when the food provisioning is regular (unpublished results), we assumed that pigeons that came each of the seven consecutive trials of the experiment could be the same. This is why we considered successive trials in the same site as being similar to successive trials for the same group of captive pigeons.

(ii) Captive feral pigeons (10 replicates of 10 individuals): they were tested within their respective aviaries (n=10) at the CEREEP field station (Centre d’Ecologie Expérimentale et Prédictive-Ecotron Ile-de-France, UMS 3194, Ecole Normale Supérieure, Saint-Pierre-lès-Nemours, France). These pigeons were first-generation descendants of free-living feral pigeons captured in the Parisian agglomeration and placed in captivity for more than two years (see Jacquin et al. 2012). They never left their aviaries. They were kept in mixed (male-female of different ages) flocks of 10 individuals and housed in outdoor aviaries of 2m x 3,5m. Outside the study period, food (commercial seed mixture of maïs, peas and wheat) and water were provided ad libitum, and generally replaced once to twice a week thus keeping human contact to a minimum. Bars within the aviaries supplied resting opportunities for pigeons, and part of the aviaries’ roof was covered providing shelter for the birds. Bathing opportunities were given through large water bowls. There was no other environmental enrichment.

(iii) Free-living domestic pigeons (5 replicates of 10-40 individuals): they were tested at the breeders’ place (close to Paris) outside, in front of their aviaries (n=5). They were housed in mixed (male-

female of different ages) flocks from 10 to 40 individuals and housed in outdoor aviaries of 1,5m x 3m. The aviaries were completely covered and pigeons had resting opportunities integrated to the walls. There was no other environmental enrichment. These birds have a daily contact with their breeder and can fly in and out of their aviary during the day. They frequently participate in pigeon races for which they are transported and released all over France and travel home by themselves. Outside the study period they were fed a commercial seed mixture by the breeder once a day and water was provided ad libitum.

(iv) Captive domestic pigeons (8 replicates of 10-60 individuals): they were tested within their aviaries (n=8) at the ecological station of the university of Pisa, Italy. All pigeons were born and reared at the place where they were tested. They were kept in similar conditions than captive feral pigeons, never leaving their aviaries. They were housed in mixed (male-female of different ages) flocks from 10 to 60 individuals and housed in outdoor aviaries of 3,5m x 4,5m to 4m x 7m. Outside the study period, food (commercial seed mixture corn, peas and wheat) and water were provided ad libitum, and generally replaced once to twice a week thus keeping human contact to a minimum. Bars within the aviaries supplied resting opportunities for pigeons, and part of the aviaries' roof was covered providing shelter for the birds. There was no other environmental enrichment.

In order to prevent biases due to changing context (Lefebvre et al. 1997), we tested all four groups of pigeons in their social group and in their respective familiar environment, without capturing them before the experiment. We removed food provision of captive groups on the evening before the first testing day. For the whole duration of the experiments (7 consecutive days) birds were fed corn seeds once a day during the performance of the test and just after, with attention paid to the fact that all birds had had access to the food. Water was provided ad libitum. Our tests provide thus information on how individuals vary in their performance under normal conditions of hunger, social interactions and feeding options, and allow assessing the bird's abilities in their usual environment (Bouchard et al. 2007, Greenberg 2003).

Treatment Groups	Free-living	Captive
Feral	10 replicates, Paris, France	10 replicates, Ecological station Nemours, France
Domestic	5 replicates, Breeder France	8 replicates, Ecological station Pisa, Italy

Table 1: Origins and numbers of replicates of the different compared groups.

II.2. Ethical Notes

The study was carried out in accordance with the recommendations of the European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes (revised Appendix A). All experiments and captures were approved by local authorities and the “Direction Départementale des Services Vétérinaires de Seine-et-Marne” (permit No. 77-05).

II.3. Measurement of environmental tolerant behaviour

We conducted tests of neophobia, flight distance and innovative problem-solving (Figure 2) by adapting methods proposed by Greenberg (1984) and Webster and Lefebvre (2001). All the measurements have been conducted by the same experimenter (ZS).

Neophobia tests: We assessed the strength of neophobia of a pigeon group by measuring the latency to feed near an unknown object. Three unknown objects were randomly used, chosen based on their discrepancy from birds’ familiar background: a pink bath puff, a cup with vertically standing wooden sticks, and an abstract object made of colored clothespins. For each replicate, we conducted six trials, i.e., 3 controls (adding no object) and 3 tests (adding an unknown object). The order of control and test trials as well as the choice of the three unknown objects was randomly determined prior to testing. We conducted one trial per day per replicate.

Each trial started by the experimenter putting 100g of corn seed on a slab (30x20cm, the slab being invisible as completely covered by the seeds) and moving 15 m away from the patch. The feeding latency of the first bird to arrive was measured. Once a bird began feeding, the experimenter waited for 20s so as to give other birds the opportunity to approach the feeding site. She then approached the food patch and the birds at a constant pace and performed either a control trial (consisting in touching the food) or an object trial (touching the food and putting one of three unknown objects 10 cm from it). The following trial the next day involved then the opposite condition. If no bird returned within 20 minutes following the interruption by the experimenter, the trial was excluded from the final data, keeping thus only those trials, where the birds returned to the food slab.

Flight distance: At each trial for neophobia measurement, flight distance was also assessed, by measuring the distance at which the birds stopped their initial feeding and moved away when the experimenter walked towards the food patch. To do that, the experimenter put a mark on the ground at the place where she was when the last bird left the feeding site, either by foot or by flying; after the end of the trial, she measured the distance between this mark and the food location with a tape.

As the group number could have an effect on the different measurements, we also recorded the number of individuals per group.

Problem-solving tests: We assessed innovative problem solving through success at obtaining food from an apparatus (clear box of 10x20x5cm covered with a Plexiglas slab) containing visible food that can be reached through different ways within the range of birds' natural behaviour. This task was performed only once per replicate, to avoid any habituation and learning, after the second neophobia trial. Each session started with the presentation of an open box with food inside. Once at least one bird pecked at the food, the experimenter waited for approximately 20s allowing other birds to approach and eat, before approaching the food patch at a constant pace and placing a Plexiglas slab. The seeds could be reached by pecking, pushing, lifting or pulling actions. If the birds succeeded, the test was scored as "solved". If a bird attempted to get access to the food from the

closed apparatus but was unsuccessful within 20 minutes, or if no bird made any attempt to reach the food in 20 min, the test was scored as “unsolved”.

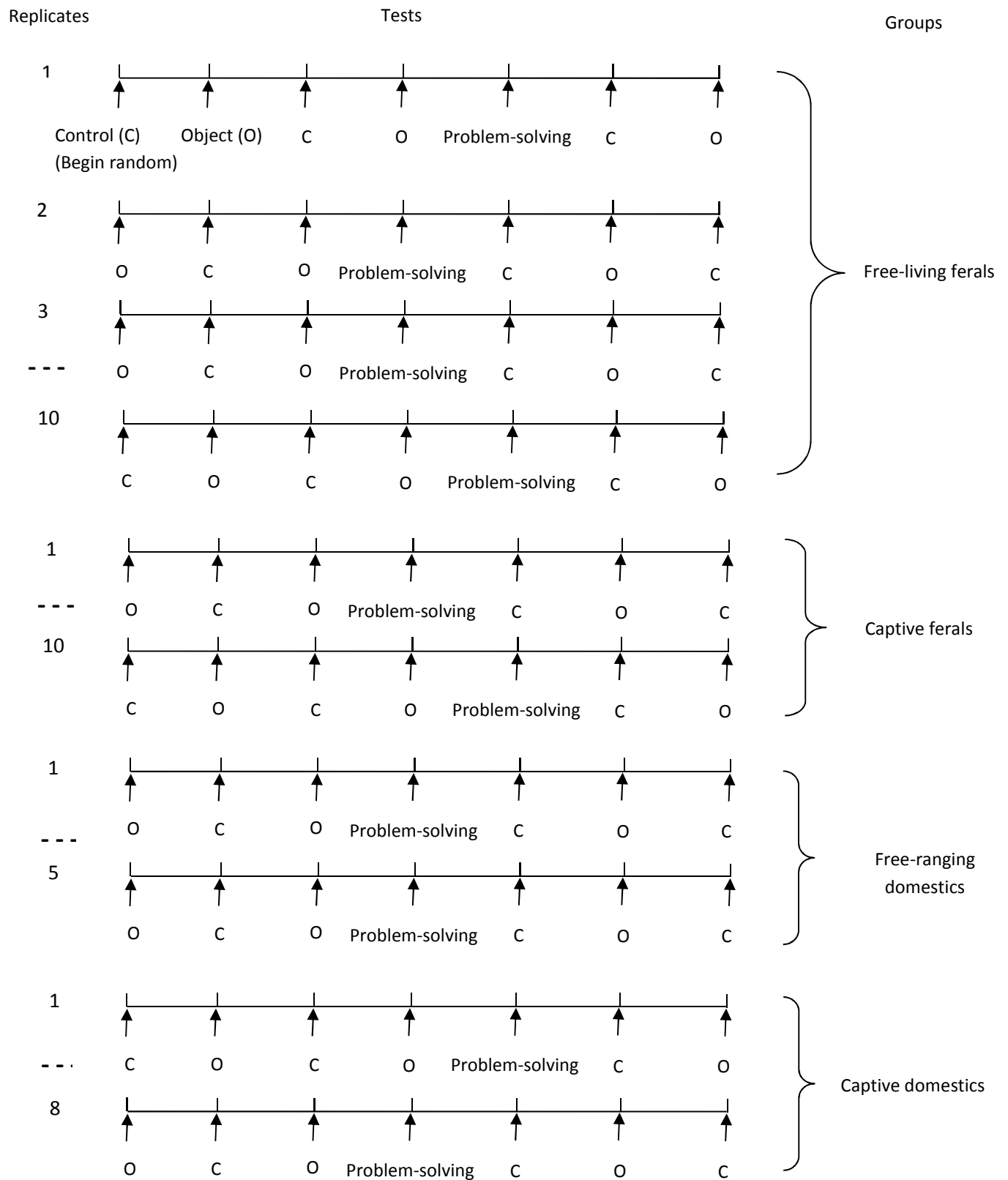


Figure 1: Hierarchical levels of the experimental protocol.

II.3. Data analyses

We were interested by behavioural differences between treatments, and more particularly between free-living/captive conditions, and between domestic/feral statuses. For each treatment, we considered the tested groups as independent replicates (from 5 to 10 depending on the treatment, Table 1).

Neophobia: For each replicate, we measured neophobia at 6 successive occasions. Because all these measures could not be considered as independent, we considered replicate as a random effect in a mixed linear model. However, the neophobia was assessed in a more complex way. Indeed, at each trial (test or control), we measured the latency to return to the feeding site after the experimenter interruption (i.e., return-latency). We considered this measure as the dependent variable in the linear model; we considered as dependent and fixed effects the latency to initial feeding and the pigeon number in the tested group. However, we assessed neophobia as the difference in return-latency between control trials and test trials. Therefore, we compared neophobia between treatments by considering the interaction between test and treatment on the return-latency. More precisely, we assessed the significance of interactions between test and both conditions (free-living/captive) and status (domestic/feral).

Flight distance: Similarly, for each replicate, we measured flight distance at 6 successive occasions. Because all these measures could not be considered as independent, we considered replicate as a random effect in a mixed linear model, with pigeon number in the tested group and treatment as fixed effects. We then computed *post-hoc* tests to specify more clearly the differences between the four treatments.

Problem-solving: The measure of problem-solving was computed only once per replicate, in a binomial way (problem solved or not, see methods). Therefore, we analyzed these data with generalized linear models (GLMs) with binomial variance and logit link function. As for neophobia, we

studied the problem-solving measure depending on pigeon number of the tested group, condition and status.

III. RESULTS

Flight distance (Table 2): Flight distance varied significantly with the pigeon number, meaning that the more numerous was the pigeon group tested, the lower was the flight distance ($P=0.032$).

Taking this into account, we found a significant effect of treatment in the flight distance ($P<1e-10$). More precisely, post-hoc tests revealed that free-living feral and free-living domestic pigeons did not significantly differ in their flight distance ($P=0.99$; Fig. 2). However, they had respectively significantly lower flight distances from captive domestic pigeons ($P<0.001$ each) and from captive feral pigeons ($P=0.011$ and $P=0.014$ respectively, Fig. 2).

<i>Response: Flight Distance</i>	Chisq	Df	Pr(>Chisq)
<i>Rearing conditions</i> <i>(captivity vs. free-living)</i>	71.4312	3	2.107e-15 ***
<i>Number</i>	4.5531	1	0.03286 *

Table 2. Analysis of Deviance Table (Type II tests) for Flight Distance. Signif. codes: 0 '***' 0.001 '**'

0.01 '*' 0.05 '.' 0.1 ' ' 1

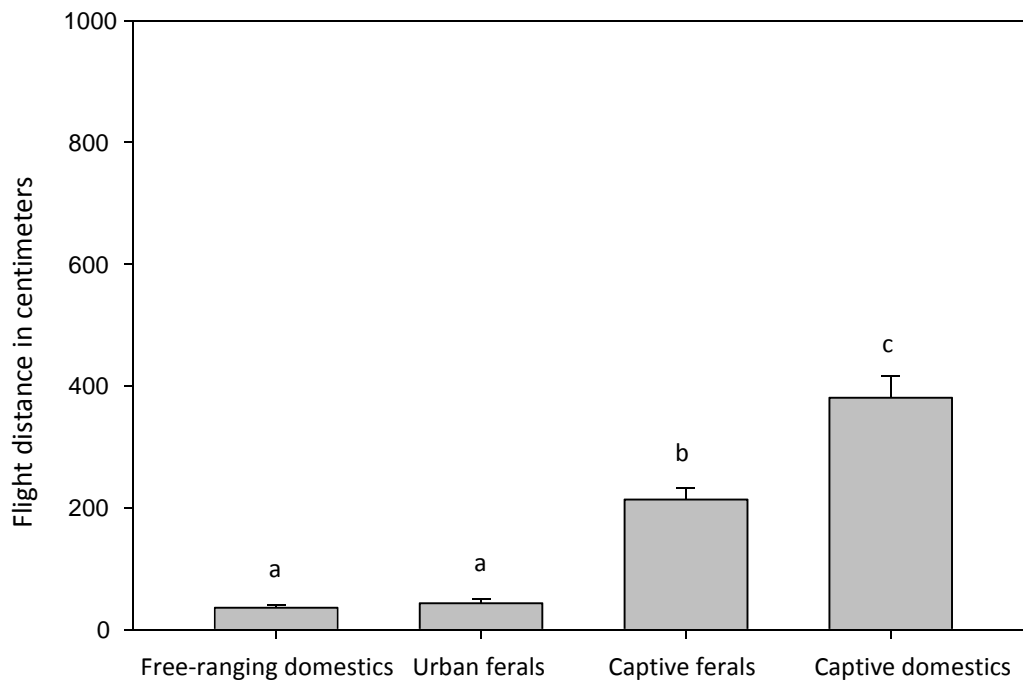


Fig.2: Average \pm se medium flight distance for each group tested

Neophobia (Table 3): The return-latency was significantly higher in trials with the presence of an unknown object (test) than in control trials without object ($P < 0.0001$). Further, we found a significant effect of pigeon number: the more numerous the tested pigeon group, the lower the neophobia ($P = 0.014$). So here again, we found a significant effect of pigeon number on the tested behaviour. Finally, captive groups (domestics and feral) were significantly more neophobic than free-living groups ($P = 0.011$; Fig.3). However, the status did not have any significant effect on neophobia ($P = 0.43$).

<i>Neophobia (Test vs. control trials)</i>	33.1203	1	8.663e-09 ***
<i>Neophobia:rearing conditions</i> <i>(captivity vs. free-living)</i>	6.3861	1	0.01150 *
<i>Neophobia:number</i>	6.0828	1	0.01365 *
<i>Neophobia: status</i> <i>(domestic vs. feral)</i>	0.6205	1	0.43085

Table 3: Analysis of Deviance Table (Type II tests) for Neophobia. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

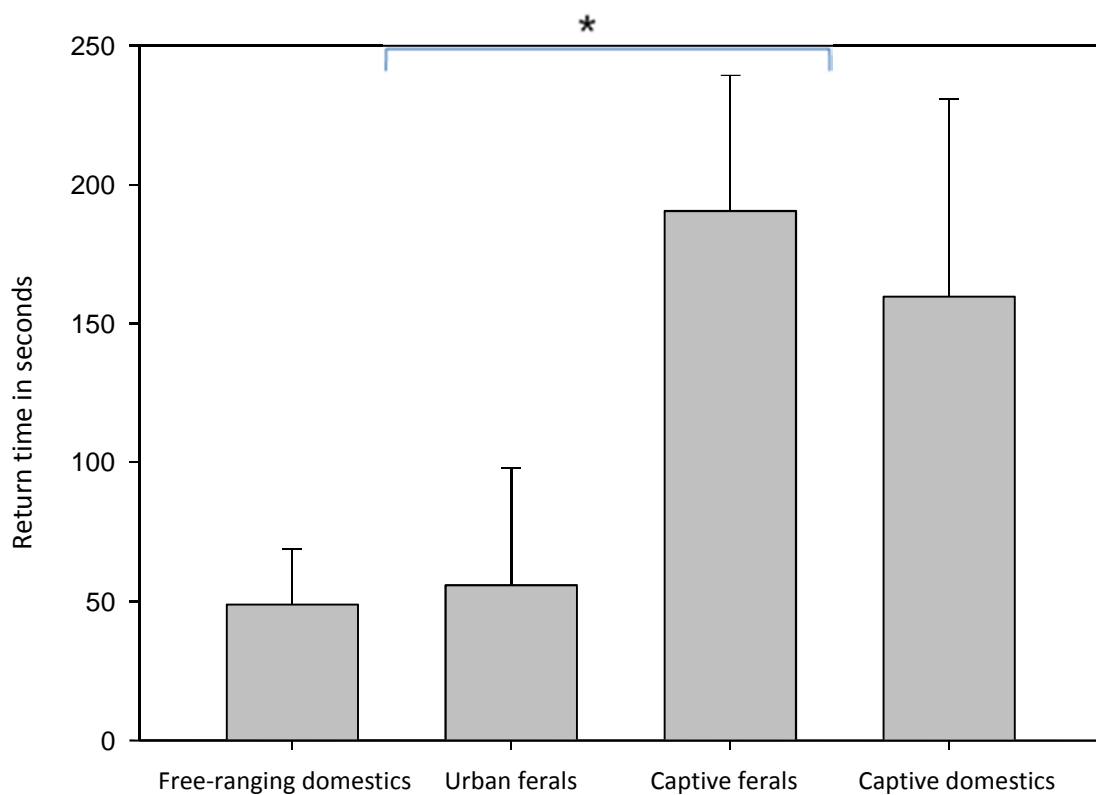


Fig. 3. Average \pm se medium return time in Neophobia trials- return time in control trials

Problem-solving (Table 4): Here again, we observed a significant effect of pigeon number on problem-solving: the more numerous, the more often pigeons gained access to the food ($P= 0.049$). Taking this into account, free-living groups succeeded more often in the problem-solving task compared to captives ($P= 0.029$; Fig. 4). However, the status did not have any significant effect on problem-solving ($P=0.21$).

<i>Response: Problem solved (access to food)</i>	Chisq	Df	Pr(>Chisq)
<i>Rearing conditions</i>	4.7385	1	0.02949 *
<i>Number</i>	3.8786	1	0.04890 *
<i>Status</i>	1.5909	1	0.20720

Table 4: Analysis of Deviance Table (Type II tests) for Problem-solving. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

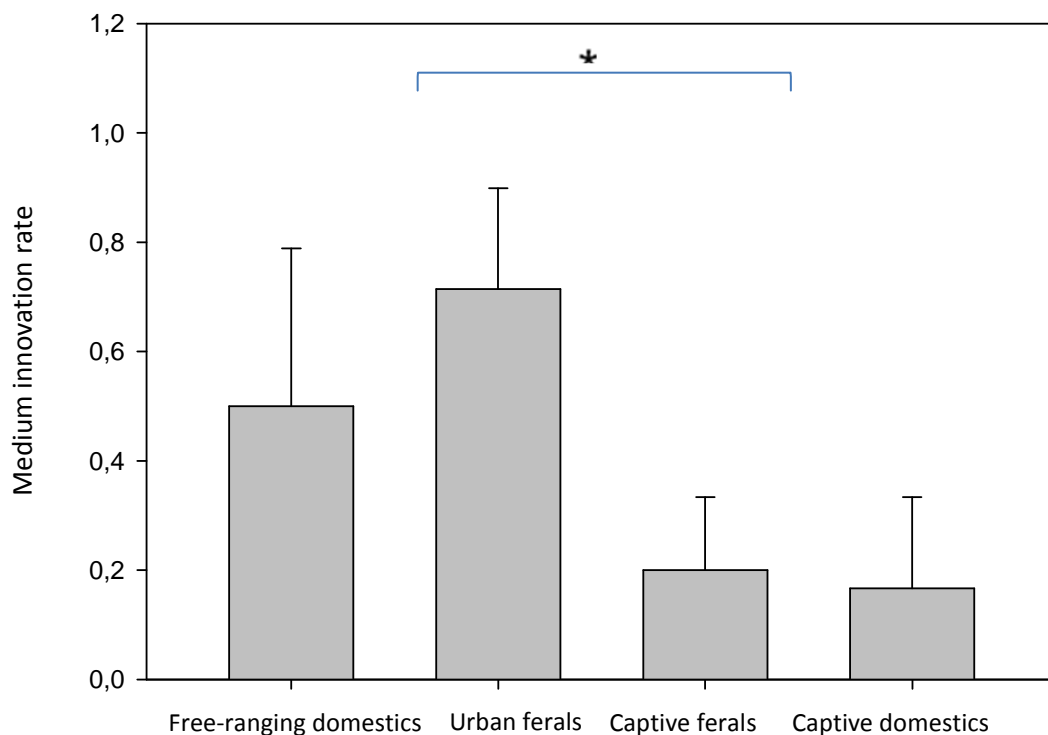


Fig. 4. Average \pm se medium innovation rate

IV. DISCUSSION

In this study, we found that ecological conditions (captive vs. free-living) affect our three measurements of environmental tolerance. In contrast, we did not find any significant effects of the status (domestic vs. feral) on this environmental tolerance.

As captive feral pigeons showed higher flight distance, higher neophobia and lower problem-solving abilities than free-living ferals but also than free-ranging domestics, whereas no difference was found between free-ranging ferals and domestics, our tests do not validate the hypothesis of increased environmental tolerance in urban birds as a result of a synanthropic adaptation. In that case, both feral groups, independently of environmental conditions, would have behaved equally but significantly different from their domestic ancestors. Our comparisons thus between captivity raised and free-ranging domestic and feral pigeons for all three standardized behavioral measures, confirm that environmental tolerance in urban birds seems to be the expression of phenotypic plasticity. The significant difference found in risk-taking, neophobia and problem-solving between captive and free-living pigeon groups suggests that variable environments may act as catalyzers.

We cannot fully exclude here that potential genetic differences between our domestic groups from Paris and from Pisa, might explain some of the differences found in our results. However, we may still be confident that such differential geographical background is not the explaining factor in our results since we didn't find any significant behavioral differences between captive domestics from Pisa and captive ferals from Paris, but did find differences within Paris between captive ferals and both free-ranging groups.

Our findings are also consistent with Soldatini et al.'s (2006) report of pigeon's flexibility in foraging flights, tuned to environmental features. Indeed, in their study on both wild rock doves (i.e. the ancestors of domestic and feral pigeons) and feral pigeons, Soldatini et al. found a strong effect of ecological factors on shaping the foraging behavior of pigeons, resulting in commuting foraging flights when resources are scarce and the suppression of these flights as soon as the colony area/city fulfills the food requirements (Soldatini et al. 2006). The adaptation of pigeons' foraging behavior to

environmental characteristics is therefore a plastic response to food availability (in our case in the urban habitat) and do not result from genetic differentiation.

Our results hence do not support Evans et al.'s (2010, 2011) statement that "[i]t is more likely [...] that optimal urban phenotypes will require genetic adaptation" (Evans et al 2010: 647) as adaptive plastic phenotypes would be more costly than genetic change and result in directional selection for extreme phenotypes which generates genetic adaptation. The adjustment to the urban environment through genetic change was however plausible in the case of the pigeon as the potential rate of such change was reported to be favored by high reproduction rate and short generation times (Evans et al. 2010). Indeed, pigeons breed several times a year (up to every two months) and reproduce all around the year as a result of artificial selection during their former domestication (Johnston and Janiga 1995). Second, changes in behavior were also reported to drive selection on morphology, which has a strong genetic basis (Price et al. 2003, Evans et al. 2010). As pigeons also went through morphological change after establishing in cities and living as feral (Jacquin et al. 2013, Johnston and Janiga 1995) the question whether selection also acted on other variables such as behavior itself was thus contiguous.

Our results propose in contrast that modifications in behavioral plasticity in response to environmental variables may not necessarily become genetically differentiated (Francis and Chadwick 2012, Yeh and Price 2004). One explanation for our results could be that plastic traits can in fact variably affect evolutionary change, by either accelerating, or slowing down, or having little effect on directional selection (Price et al. 2003): moderate levels of plasticity would be optimal in enabling adaptive genetic differentiation if maintaining plasticity is costly (e.g., in a homogeneous environment, de Witt et al. 1998, Ancel 2000, Sultan and Spencer 2002). In contrast, high plastic traits, such as behavior (Price et al. 2003), may allow higher fitness in heterogeneous environments. In that case, being plastic may become the selected trait.

We also found that group number affected the display of environmental tolerance in the form of lower flight distance/higher risk-taking, lower neophobia and higher innovative problem solving. This

confirms the common characterization of gregarious species (Coleman and Mellgren 1994, Kark et al. 2007). These characteristics may make urban exploitation easier and allow the species to persist at best in dense anthropic surroundings. Sociality represents indeed an advantage when group foraging behavior (as in our experiments) ensures opportunities of learning from others birds' experiences and enhances the ability to communicate about food location or predation and/or risk avoidance (Ward and Zahavi 1973). In addition, the allocation of time to vigilance decreases with group size, because being in a group reduces the individual risk of attack (Kark et al. 2007) and more individuals are vigilant for predator presence (the many-eyes hypothesis: Pulliam 1973). Wang et al. (2011) also reported that vigilance in red-crowned cranes (*Grus japonensis*) not only decreased linearly with flock size but even more in disturbed compared to less disturbed areas.

In conclusion, our results confirm the hypothesis that environmental tolerance in pigeons is the expression of phenotypical plasticity as adaptation to cities' specific heterogeneous environmental conditions. To take over an image of Croci et al. (2008) on environment filters, we propose that urban environments act as not only one, but two filters, a first selective one, and a second reversed filter which may amplify species' natural predispositions and faculties.

ACKNOWLEDGMENTS

We would like to express a special thanks to all people that helped in the study: Fabio Chini, Samuel Perret, David Otamendi and the Cité Universitaire Internationale de Paris, CSME colombophilie of Epinay sur Seine and Guy Lemoine, Ahmad Ismail, Ahmed Belguermi, Michel Saint Jalme, Iry Andrianjara and the city of Paris for delivering bird feeding authorization.

REFERENCES

- Ancel L. W. 2000. Undermining the Baldwin expediting effect: does phenotypic plasticity accelerate evolution? *Theor. Popul. Biol.* 58: 307–319.
- Atwell J.W., Cardoso G.C., Whittaker D.J., Campbell-Nelson S., Robertson K.W., Ketterson E.D. 2012. Boldness behavior and stress physiology in a novel urban environment suggest rapid correlated evolutionary adaptation. *Behavioral Ecology* 23(5): 960-969.
- Badyaev A.V., Young, R.L., Oh K.P., Addison C. 2008. Evolution on a local scale: developmental, functional, and genetic bases of divergence in bill form and associated changes in song structure between adjacent habitats. *Evolution* 62: 1951-1964.
- Bates D., Maechler M., Bolker B., Walker S. 2014. lme4: Linear mixed-effects models using Eigen and S4. R package version 1.0-6. <http://CRAN.R-project.org/package=lme4>
- Blumstein D.T. 2006. Developing an Evolutionary Ecology of Fear: How Life History and Natural History Traits Affect Disturbance Tolerance in Birds. *Animal Behaviour* 71:389–399.
- Bonier F., Martin P. R., Wingfield J. C. 2007. Urban birds have broader environmental tolerance. *Biology Letters* 6: 670–673.
- Bond A., Kamil A., Balda R.P. 2007. Serial Reversal Learning and the Evolution of Behavioural Flexibility in Three Species of North American Corvids (*Gymnorhinus cyanocephalus*, *Nucifraga columbiana*, *Aphelocoma californica*). *Papers in Behaviour and Biological Sciences* 20:372-379
- Boogert N.J., Reader S.M., Laland K.N. 2006. The Relation Between Social Rank, Neophobia and Individual Learning in Starlings. *Animal Behaviour* 72:1229-1239.
- Bouchard J., Goodyer W., Lefebvre L. 2007. Social Learning and Innovation are Positively Correlated in Pigeons (*Columba livia*). *Animal Cognition* 10:259–266.
- Brown C. R. and Bomberger Brown M. 2013. Where has all the road kill gone? *Current Biology* 23(6):233-234.
- Chace J.F. and Walsh J.J. 2006. Urban effects on native avifauna: a review. *Landscape and Urban Planning* 74: 46–69.

Coleman S.L. and Mellgren R.L. 1994. Neophobia when feeding alone or in flocks in zebra finches, *Taeniopygia guttata*. *Animal Behaviour* 48: 903–907.

Corey D.T. 1977. The Determinants of Exploration and Neophobia. *Neuroscience and Behaviour Review* 2:235-53.

Croci S., Butet A., Clergeau P. 2008. Does urbanisation filter birds on the basis of their biological traits? *The Condor* 110, 223–240.

Day L. B., Crews D., Wilczynski W. 1999. Spatial and Reversal Learning in Congeneric Lizards with Different Foraging Strategies. *Animal Behaviour* 57:393–407.

de Planhol X. 2004. *Le Paysage Animal. L’Homme et la Grande Faune : Une Zoogéographie Historique*. Paris : Fayard.

de Witt T. J., Sih A., Wilson D. S. 1998. Costs and limits of phenotypic plasticity. *Trends Ecol. Evol.* 13: 1–8.

Evans K.L., Hatchwell B.J., Parnell M., Gaston K.J. 2010. A conceptual framework for the colonization of urban areas: the blackbird *Turdus merula* as a case study. *Biological Reviews* 85: 643–667.

Evans K.L., Chamberlain D.E., Hatchwell B.J., Gregory R.D., Gaston K.J. 2011. What makes an urban bird? *Global Change Biology* 17: 32–44.

Fox R.A., Millam J.R. 2007: Novelty and Individual Differences Influence Neophobia in Orange-winged Amazon Parrots (*Amazona amazonica*). *Applied Animal Behaviour Science* 104: 107–115

Fox R.A., Millam J.R. 2004. The Effect of Early Environment on Neophobia in Orange-winged Amazon parrots (*Amazona amazonica*). *Applied Animal Behaviour Science* 89:117–129

Francis D.D., Diorio J., Plotsky P.M., Meaney M.J. 2002. Environmental Enrichment Reverses the Effects of Maternal Separation on Stress Reactivity. *Journal of Neuroscience* 22:7840–7843.

Francis R.A., Chadwick M.A. 2012. What makes a species synurbic? *Applied Geography* 32:514-521.

Gibbs D., Barnes E., Cox J. 2001. *Pigeons and doves: a guide to the pigeons and doves of the world*. Robertsbridge: Pica Press.

- Greenberg R. 1984. Differences in Feeding Neophobia in the Tropical Migrant Wood Warblers, *Dendroica castanea* and *D. pensylvanica*. *Journal of Comparative Psychology* 98:131–136.
- Greenberg R., Mettke-Hofmann C. 2001. Ecological Aspects of Neophobia and Neophilia in Birds. *Current Ornithology* 16:119-178.
- Greenberg R. 2003. The role of Neophobia and Neophilia in the Development of Innovative Behaviour of Birds. In: *Animal Innovation*, S. M. Reader & K. N. Laland Eds., pp. 175-196. New York: Oxford University Press.
- Grimm N. B., Grove J. M., Pickett S. T. A., Redman C. L. 2000. Integrated approaches to long-term studies of urban ecological systems. *BioScience* 50:571-584.
- Hagemeijer W. J. M. and Blair M. J. 1997. *The EBCC Atlas of European Breeding Birds: Their Distribution and Abundance*. London: T. & A. D. Poyser.
- del Hoyo J., Elliott A., Christie D. (eds.) 2005. *Handbook of the Birds of the World vol. 10*. Lynx Ediciones, Barcelona.
- Jacquin L., Récapet C., Prévot-Julliard A-C., Leboucher G., Lenouvel F., Erin T., Frantz A., Corbel, Gasparini J. 2013. A potential role for parasites in the maintenance of bird color polymorphism in cities. *Oecologia* 173:1089-1099.
- Jacquin L., Blottiere M., Haussy L., Perret S., Gasparini J. 2012. Prenatal and postnatal parental effects on immunity and growth in 'lactating' pigeons. *Functional Ecology* 26: 866-875.
- Johnston R. F. and Janiga M. 1995. *Feral Pigeons*. New York: Oxford Univ. Press.
- Jokimäki J. and Suhonen J. 1998 Distribution and habitat selection of wintering birds in urban environments. *Landscape and Urban Planning* 39: 253–263.
- Jones C. B. 2005. *Behavioural Flexibility in Primates: Causes and Consequences*. New York: Springer-Verlag.
- Kark S., Iwaniuk A., Schalimtzek A., Banker E. 2007. Living in the city: can anyone become an 'urban exploiter'? *Journal of Biogeography* 34: 638–651.

Kettlewell HBD. 1961. The phenomenon of industrial melanism in Lepidoptera. *Annual Review of Entomology* 6:245–262.

Klausnitzer B. 1989. *Verstädterung von Tieren*. Wittenberg: Neue Brehmer Bücherei.

Lefebvre L., Whittle P., Lascaris E., Finkelstein A. 1997. Feeding innovations and Forebrain Size in Birds. *Animal Behaviour* 53: 549–560.

Marples N. M., Roper T. J., Harper D. G. C. 1998. Responses of Wild Birds to Novel Preys: Evidence of Dietary Conservatism. *Oikos* 83:161–165.

Marzluff J. M. and Ewing K. 2001. Restoration of fragmented landscapes for the conservation of birds: a general framework and specific recommendations for urbanizing landscapes. *Restoration Ecology* 9:280–292.

Mayr E. 1965. The Nature of Colonising Birds. In: *The Genetics of Colonizing Species*, H. G. Baker & G. L. Stebbins Eds., pp. 29–43. New York: Academic Press.

McKinney M.L. 2008. Effects of urbanization on species richness: A review of plants and animals. *Urban Ecosystems* 11(2) : 161-176.

McKinney M.L. 2002. Urbanization, Biodiversity, and Conservation. *BioScience* 52(10): 883-890.

Mettke-Hofmann C., Winkler H., Leisler B. 2002. The significance of Ecological Factors for Exploration and Neophobia in Parrots. *Ethology* 108:249-72.

Møller A.P. 2008. Flight Distance of Urban Birds, Predation, and Selection for Urban Life. *Behavioural Ecology and Sociobiology* 63:63–75.

Møller A.P. 2009. Successful City Dwellers: a Comparative Study of the Ecological Characteristics of Urban Birds in the Western Palearctic. *Oecologia* 159: 849–858.

O'Daly M., Case D.A., Fantino E. 2006. Influence of budget and reinforcement location on risk-sensitive preference. *Behavioural Processes* 73: 1215-135.

Price T., Qvarnström A., Irwin D.E. 2003. The role of phenotypic plasticity in driving genetic evolution. *Proceedings of the Royal Society of London B* 270: 1433–1440.

- Pujol B. and Pannell J.R. 2008. Reduced responses to selection after species range expansion. *Science* 321: 96.
- Pulliam H.R. 1973. On the advantages of flocking. *Journal of Theoretical Biology* 38: 419–422.
- Reader S.M., Laland K.N. 2002. Social intelligence, Innovation, and Enhanced Brain Size in Primates. *Proceedings of the National Academy of Sciences of the United States of America* 99:4436–4441.
- R-Development-Core-Team 2010. R a language and environment for statistical computing. R Foundation for statistical computing. URL: <http://www.R-project.org>, Vienna, Austria.
- Rosenzweig M. L. 2003. Reconciliation Ecology and the Future of Species Diversity. *Oryx* 37(2):194–205.
- Seastedt T., Hobbs R. J., Suding K. N. 2008. Management of novel ecosystems: are novel approaches required? *Frontiers in Ecology and Environment* 6:547–553.
- Seferta A., Guay, R-J. Marzinotto E., Lefebvre L. 2001. Learning Differences Between Feral Pigeons and Zenaida Doves: The Role of Neophobia and Human Proximity. *Ethology* 107:281–93.
- Slabbekoorn H. and Den Boer–Visser A. 2006. Cities change the songs of birds. *Current Biology* 16, 2326–2331.
- Sol D. and Lefebvre L. 2000. Behavioural Flexibility Predicts Invasion Success in Birds Introduced to New Zealand. *Oikos* 90(3):599–605.
- Sol D., Timmermans S., Lefebvre L. 2002. Behavioural Flexibility and Invasion Success in Birds. *Animal Behaviour* 63: 495–502.
- Sol D., Duncan R.P., Blackburn T.M., Cassey P., Lefebvre L. 2005. Big Brains, Enhanced Cognition, and Response of Birds to Novel Environments. *Proceedings of the National Academy of Sciences of the United States of America* 102: 5460–5465.
- Sol D. 2007. Do successful invaders exist? Pre-adaptations to novel environments in terrestrial vertebrates. In: *Biological invasions*, W. Nentwig Ed. pp. 127–141. Berlin: Springer.
- Sol D., Bacher S., Reader S.M., Lefebvre L. 2008. Brain Size Predicts the Success of Mammal Species Introduced into Novel Environments. *The American Naturalist* 172:S63–S71.

- Stephen S., Ditchkoff S., Saalfeld T., Gibson C.J. 2006. Animal behaviour in urban ecosystems: Modifications due to human-induced stress. *Urban Ecosyst* 9: 5–12
- Stirling D.G. and Lefebvre L. 2005. Behavioural Drive or Behavioural Inhibition in Evolution: Subspecific Diversification in Holarctic Passerines. *Evolution* 59(12):2669-2677.
- Stringham S.A., Mulroy E.E., Xing J., Record D., Guernsey M.W., Aldenhoven J.T., Osborne E.J., Shapiro M.D. 2012. Divergence, Convergence, and the Ancestry of Feral Populations in the Domestic Rock Pigeon. *Current Biology* 22: 1–7.
- Sultan S.E. and Spencer H.G. 2002. Metapopulation structure favors plasticity over local adaptation. *Am. Nat.* 160: 271–283.
- Timmermans S., Lefebvre L., Boire D., Basu P. 2000. Relative Size of the Hyperstriatum Ventrale in the Best Predictor of Feeding Innovation Rate in Birds. *Brain Behaviour and Evolution* 56:196–203.
- Tomasello M. and Call J. 1997. *Primate cognition*. Oxford: Oxford University Press.
- Vitousek P.M., Mooney H.A., Lubchenco J., Melillo J.M. 1997. Human Domination of Earth's Ecosystems. *Science* 277: 494-499.
- Wang Z., Li Z., Beauchamp G., Jiang Z. 2011. Flock size and human disturbance affect vigilance of endangered red-crowned cranes (*Grus japonensis*). *Biological Conservation* 144(1): 101-105.
- Ward P. and Zahavi A. 1973. The importance of certain assemblages of birds as "information-centres" for food finding. *Ibis* 115:517-534.
- Webster S.J., Lefebvre L. 2001. Problem Solving and Neophobia in a Columbiform–Passeriform Assemblage in Barbados. *Animal Behaviour* 62:23–32.
- Wilson A.C. 1985. The molecular Basis of Evolution. *Scientific American* 253:148–157.
- Wright T.F., Eberhard J.R., Hobson E.A., Avery M.L., Russello M.A. 2010. Behavioural Flexibility and Species Invasions: The Adaptive Flexibility Hypothesis. *Ethology Ecology & Evolution* 22:393–404.
- Yeh P. J. and Price, T. D. 2004. Adaptive phenotypic plasticity and the successful colonisation of a novel environment. *American Naturalist* 164: 531–542.

CHAPTER 2

Nuisance Species: Beyond the Ecological Perspective

CHAPTER INTRODUCTION

When animals colonize new niches by adapting to and settling in places different from their original ecosystems, they may present a visible contradiction to human definitions of these landscapes and their assigned species. In particular, cities are subject to an ordering process that clearly determines what can be included and what does not belong to it (Griffiths and Poulter 2000). In such cases, species disturbing defined spatial relations that underlie human qualifications of biodiversity may become labeled as ‘nuisance’ species (Jerolmack 2008, Philo and Wilbert 2000). These concepts revive the founding myths of Western societies, from the Plagues of Egypt to the Odyssey or the *Pied Piper of Hamelin*, revealing the inherent fears and unease raised by this disorder (Claeys and Sirost 2010). An additional question emerges from these connotations of threat: what is at stake behind the spatial ordering of biodiversity?

The following chapter seeks to move the concept of ‘nuisance species’ away from only ecological considerations toward an interpretist view of such environmental classifications as socially and historically grounded (Fine 1997). We propose a new, complementary explanation for considering some species as nuisances, based on what we termed their socio-nature characteristics. Using the example of the heated debate over pigeons (*Columba livia*) as a case study, we analyze in a historical perspective the understanding of pigeons as pests, as well as the ecological, social, economic, and political relations at stake in these narratives; further, we clarify what particular discourses of and about non-humans in general are mobilized in them.

However, when focusing only on how animal species are represented, it may seem that they are merely passive surfaces onto which human groups project meanings (Philo and Wilbert 2000). This is why we sought to demonstrate how animals themselves may figure dialectically in these practices and the extent to which they destabilize or resist human orderings. More specifically, we emphasized the ways that the behavioral traits and the ecology of species, and of pigeons in this particular case, have guided and constrained the social meanings they were attributed.

Reciprocally, each actor's identity in these discourses becomes what it is through its specific relationship to the other instead of being independently formed, pre-existing relations and is then joined to the whole (Robbins 2007). Using social representations theory, we thus highlight issues of human identity definition that are at stake in the construction of pigeons as a nuisance species.

These concurrent social-ecological processes provide crucial insight regarding the context in which the presence of urban biodiversity is currently being debated.

ARTICLE

Nuisance Species: Beyond the Ecological Perspective

Zina Skandrani^{1*}, Sébastien Lepetz², Anne-Caroline Prévot-Julliard¹

Published in: Ecological Processes 2014, 3(3): 1-12.

¹ Centre d'Ecologie et des Sciences de la Conservation CESCO, UMR 7204 CNRS-MNHN-UPMC, Museum National d'Histoire Naturelle, CP 51, 55 rue Buffon, F-75005, skandrani@mnhn.fr, acpj@mnhn.fr

² Laboratoire d'Archéozoologie et Archéobotanique, UMR 7209 CNRS-MNHN, Museum National d'Histoire Naturelle, 55 rue Buffon, F-75005, lepetz@mnhn.fr

*Corresponding author

KEYWORDS: 'nuisance species'; socio-natures; social representations; human-animal relations; identity construction.

I. INTRODUCTION

‘Nuisance species’ (or ‘invasive species’ or ‘alien species’) are often proposed to be the second most important concern in the context of the current biodiversity crisis (Lowe et al. 2000; Wilcove et al. 1998) because they are a potential threat to native species through predation, grazing, competition, parasitism, disease, hybridization, or habitat alteration (Nunez et al. 2010; Elliott et al. 2010; Salo et al. 2006; Mooney et al. 2005; Pimentel et al. 2001). Since Elton (1958), the bias against alien species, which was expressed in their description as nuisances, has widely been embraced by the public, scientists, conservationists, land managers, and policy-makers and has given birth in the 1990s to a discipline in its own right, ‘invasion biology’. In biological conservation textbooks, invasive or nuisance species are described as more dangerous than environmental degradation, habitat fragmentation, and pollution because these may be more restrained and reversible than the reproduction and dispersal dynamics of nuisance species (for example, Primack et al. 2012). In addition to their potential devastating effects on natural ecosystems, nuisance species also have more general negative impacts on human beings. The IUCN, for instance, has proposed: ‘They are causing significant damage to ecological, economic, and health levels. As a matter of fact, they can compete with native species, act as pests or pathogens for cultivated or domesticated species, or even disseminate allergic or infectious agents.’ (International Union for Conservation of Nature, 2013).

These generalized discourses about invasive species, however, have been increasingly debated and challenged in recent years (Marion 2013; Davis et al. 2011; Valéry et al. 2008; Warren 2007; Falk-Peterson et al. 2006; Colautti and MacIsaac 2004) than other causes of biodiversity loss (Stuart et al. 2004; Davis et al. 2011). Although some alien species can constitute real threats to native species or habitats, case-by-case studies are needed to explore their context-dependent impacts. Some species introduced by human beings are indeed destructive, for instance, zebra mussels (*Dreissena polymorpha*) in the Great Lakes, while in other places they can increase biodiversity (the

honeysuckle, for instance, favors native bird species in Pennsylvania; Davis et al. 2011). It is also possible for native species to have similar devastating effects (Valéry et al. 2009). Because it is impossible to return to past ecosystems that have been increasingly transformed by a plethora of irreversible drivers of change (climate change, nitrogen eutrophication, increased urbanization, and other land-use changes), there has been an increased push to acknowledge ‘novel ecosystems’ (Chapin and Starfield 1997), which are composed of new combinations of species under new abiotic conditions. Therefore, many authors advocate for adaptive ecosystem management, focusing on the resilience of desirable states, rather than targeting the often-impossible eradication of undesirable species (for example, Seastedt et al. 2008).

Despite evidence that the nuisance status of some species has often been globally exaggerated, this ‘bioxenophobia’ (Marion 2013), which is based on the myth of stable and pure fauna or flora, persists. This suggests that more issues are at stake regarding the concept of nuisance species than the explicit ecological and environmental problems (Fazey et al. 2006; Wallace 2003). By widening our perspective, we can recognize that environments are combined constructions of physical, ecological, and social elements (Swyngedouw 1999). In this perspective, socio-physical constructions and environmental issues, such as nuisance species, are the consequences of interwoven socio-ecological processes (Heynen 2006). Following Swyngedouw (1999:445), ‘natural or ecological conditions and processes do not operate separately from social processes, and [...] the actually existing socio-natural conditions are always the result of intricate transformations of pre-existing configurations that are themselves inherently natural and social.’ (See also, Minter and Collins 2005).

In this paper, we provide non-ecological evidence that advocates for the need to use caution when dealing with the alien species issue. We argue for a novel explanation of nuisance species as belonging to ‘socio-natures’ (see Swyngedouw 2004, 1999, Castree and Braun 2001) that, beyond de facto ecological considerations, are historically produced and continuously reformed by networks of

human and non-human 'actants' (Latour 1993). 'In such a network of associations, each of the separate pieces is not independent, but is instead made to be the way it is by virtue of its relationship to all the other parts. [...] Nor is the identity of each actor independently formed and then joined to the whole. Instead, each becomes what it is through its specific relation to the other,' (Robbins 2007:14).

We used the case study of the heated debate over feral pigeons (*Columba livia*), which are widely considered pests, to explore the socio-nature of nuisance species (Blechman 2006). We propose a new approach to this problem through the analysis of ecological, social, economic, and political relations, as well as power geometries, underlying this problem (Heynen 2006; Blaikie 1999). The case of the pigeon is particularly telling in this regard, as they have over history 'perhaps taken on more symbolic and functional roles than any other bird,' (Jerolmack 2008:74). Indeed, they originate from formerly domesticated pigeons that returned to a free state of living (that is, ferality). These were the first birds to be domesticated over 5,000 years ago, as their ancestors, wild rock doves, came to forage on cultivated fields in direct proximity to human beings (Johnston and Janiga 1995). Domestication created the white-colored pigeons that are famous in mythology, religions, and literature as 'doves'. Feral urban pigeons (which we shall refer to as urban pigeons) are found in all major cities around the world (del Hoyo et al. 2005) and are today the birds with the closest contact to people in cities; currently, these pigeons are mostly ascribed with a highly negative image (Vuorisalo et al. 2001).

Relying on an examination of the changing meaning of pigeons, we clarified, in some historical depth, what particular discourses and understandings of and about non-human beings are mobilized in the modern perception of pigeons as a nuisance species. Finally, we show that pigeons themselves have their own agency in shaping these (re)-configurations and hold an essential and active part in the system.

II. METHODS

We retraced the evolution of pigeon representation in France through an extensive review of ancient texts related to pigeons in the following domains: religious, legal, economic, administrative, and literary, and in military reports, and treatises on zoology, agriculture, medicine, and cooking. We used texts available from the French numerical library Gallica from the Bibliothèque Nationale de France (2013), which provides access to over a million and a half documents, representative of the documents issued in France over the past centuries, that have been digitized by the Bibliothèque Nationale de France and other partner libraries. We searched for the French terms for pigeon (pigeon) and dove (colombe) and reviewed more than 240 source texts, dating from the seventh century (except for the Old Testament, which dates from the eighth to the second century BCE) to the 1990s. We narrowed the selection to 50 texts that reflected the variability of all the information and arguments. We selected these texts based on their pertinence to our subject, as a large part of the reviewed documents mentioned the words pigeon (pigeon) and dove (colombe) without providing any relevant information or providing repetitive material, such as the dove being a representation of the Holy Spirit.

To put pigeon representations into their historical frameworks, we completed these data with literature on human-animal relationships and animal conceptions in religious, philosophical, scientific, and political currents of thought that were representative of Western and, specifically, French tradition.

III. RESULTS

Based on our historical search, we found a strong shift in the mid-twentieth century in the image of the pigeon, from a very positive historical representation to its current mostly negative image in mainstream public opinion.

III.1. When pigeons were still gentle doves...

In the religious realm, doves were often portrayed as animal companions to gods, such as the love goddess Kamadeva in Hinduism, and also as representations of gods themselves, as with Aphrodite and Venus, the goddesses of love in Ancient Greece and Rome (La Ville de Mirmont 1894). In Christianity, Christ received the Holy Spirit descending in the shape of a dove during his baptism (Raban Maur 842–847, in Voisenet 2000). In Islam, a pair of pigeons saved the prophet Mohamed's life by nesting in front of the cave he was hiding in and, in this way, misled his persecutors (Lings 1986).

Doves hold the role of divine messengers in various cultures. In Ancient Egypt, they uttered to oracles (Allys 1909, Bonnery 1909); in Ancient Rome, they constituted divine auguries (La Ville de Mirmont 1894); in the Old Testament story of Noah's Ark, they announced that the waters of the Flood had drained away by bringing back an olive branch from terra firma and thus announced God's forgiveness (Jerolmack 2007); and finally, in the Christian Hagiography they revealed to a pregnant mother the sanctity of her child by laying three drops of milk on her mouth, and afterwards the saint's impending martyrdom, through three drops of blood (Raban Maur 842–847, in Voisenet 2000). Consequently, the dove is the most cited animal within the Holy Scriptures (it is cited nearly 50 times) and illustrates Christian virtues, such as purity, simplicity of heart and soul, gentleness, and chastity (Voisenet 2000). These sacred representations largely influenced the famous symbol of the dove of peace and the literary figure of the romantic dove (La Fontaine 1678), that are still common in modern times.

The attribution of these symbolic charges to doves was related to the functions of pigeons in historical times. In medieval Christian logic, animals were symbolically separated into two opposite groups, representing good or Christ and the devil or Satan, to serve a moral purpose. These representations were supposed to help human beings situate themselves between vice and virtue and choose one of the two orders (Ribémont 1992). Birds, and among them doves, were used in this

context as a pedagogical model to convey a spiritual message, encouraging human beings to behave better in life. Based on their faculty to move between the sky and the earth and to escape terrestrial confines, birds, and doves, established a connection between reality and the ideal, as well as the material and the spiritual. By linking them, they showed that conciliation between both was possible (Ribémont 1992). The wing symbolism was largely developed to exemplify the elevation of the human spirit and soul. It illustrated the progress dynamic and invited human beings to surpass themselves. Furthermore, because of their monogamous habits (Giunchi et al. 2007), doves also incarnated the ideal of the morally valued chastity and monogamy. Thus, doves became an instrument of the divine and were positively charged in support of the Christian quest for perfection and redemption (Voisenet, 2000).

However, in addition to this moral function, domestic pigeons also had different uses in everyday life. They were bred for their meat and for the use of their nitrogen-rich feces as fertilizer (Thiébaud de Berneaud 1841, Bourguignon 1882), to be used as messengers for communication purposes, and (although to a lesser extent) they were used for pleasure or sport (Johnston and Janiga 1995; de Planhol 2004). In the first French encyclopedias, which related the customs and representations of their time, pigeons were described as extremely profitable animals, and a special emphasis was placed on their value through the listing of their numerous uses and different breeds (Corneille 1694; Diderot and D'Alembert 1751; Lunel 1858).

Pigeon meat was, until the second half of the twentieth century, the second most eaten poultry and was mentioned just after chicken in cookbooks (Menon 1749; Foy 1845; Viard 1851; Courchamps 1853; Breteuil 1860) and treatises on agriculture (Rengade 1887; Brévans 1892; Favre 1905; Bonnier 1922). In France, the right to have dovecotes and keep pigeons was reserved for lords (De Ferriere 1741; Renaudon 1765) until the French Revolution in 1789. Pigeons were thus, in this context, an outward sign of nobility (Hoüard 1780; Henry 1981). After the abolition of this aristocratic privilege in 1789 (Gayot 1876; Rupin 1884), the breeding of pigeons was encouraged in the countryside and in

cities as a means to provide families of the lower working class with meat and an additional financial resource until World War II (Bois 1847). Pigeon meat was indeed regularly cited in recipes in the gastronomic sections of journals during that period and in serial narrations of feasts. However, it appears from the sophisticated character of these menus that pigeon meat was still considered a delicacy and had maintained its former noble connotations inherited from its status under the Ancien Régime (Givois, unpublished data). The use of pigeon organs, blood, and feces or as a whole in popular medicine (Moquin-Tandon 1860; Spalikowski 1895; Reutter 1916; Hermant and Boomans 1928), contributed to this image of a precious and valuable animal.

The highest praise for pigeons was, however, expressed in the aftermath of the support they provided as messengers (they can be bred as carrier or homing pigeons) during various military conflicts. Pigeons were indeed already used for postal services in ancient times by Egyptians, Greeks, Romans, Hebrews, Persians, Chinese and Arabs, they were (re-)imported to early medieval Europe during the Crusades and in the context of commercial exchange (Van der Linden 1950). They were thus employed at the time of Caesar's conquest of Gaul to inform Rome of the progress of the invasion, during Hannibal's advancement through Europe (Jerolmack 2007) to announce the loss of the Battle of Waterloo to Napoleon I (Palliez 1932), or in a more civil context, to report earthquakes in Japan, to announce the return of ships of all nationalities into harbors (Gérardin 1905), and for communication between distant castles (Guidez 1969). In the nineteenth and twentieth centuries, messenger or soldier pigeons were used at an even larger scale during the Franco-Prussian War, and the liberation of besieged Paris in 1871 was only made possible through the exchange of thousands of messages and photographs carried by pigeons between Paris and London (Bulletin Technique du Génie Militaire 1936). Consequently, the breeding of homing pigeons was publicly advocated by political leaders and scientific experts. Despite the coming age of modern communication technologies, such as the telegraph and telephone, pigeons remained crucial during World Wars I and II to request munitions military support on the front lines and to inform about the progress of

the enemy lines, as the other communication lines were easily destroyed and messages were intercepted or tapped (Gérardin 1905; Palliez 1932; Jerolmack 2007).

The ensuing allocation of public funding by the French government for pigeon fancier associations (Conseil Général. Rapports et Délibérations 1893, 1894, 1902, 1903, 1926, 1934) and the erection of monuments dedicated to pigeon soldiers in Lille (France) and Brussels (Belgium) confirm the extremely positive representation of pigeons during this period. At the same time, feeding street pigeons was such a common leisure pastime that urban parks had dedicated feeding sites and seed sellers.

III.2. Pigeons (un)wanted: dead or alive

This image is in sharp contrast with the current often-expressed dislike for pigeons. The progressive transformation of the representation of pigeons, from positive to negative, in the mid-twentieth century occurred contemporaneously with their unchecked proliferation in cities (Vuorisalo 2001), sanitary considerations, and the disappearance of historical uses for pigeons. The presence of pigeons in cities was already mentioned, anecdotally, in Nuremberg (Germany) in the twelfth century and in London (United Kingdom) in the fourteenth century (de Planhol 2004). In France, the pigeon was described in treatises and natural histories of pigeons at the end of the nineteenth century and at the beginning of the twentieth century as a free-ranging bird of domestic origins, living on farms and in the countryside (La Perre de Roo 1877; Barot 1891; Valette 1910). Pigeons were further counted among migrant species (Gayot 1876) and reported to be present only two or three times a year (Crespon 1844). From the mid-twentieth century on, pigeons moved towards urban areas and into human proximity. It is thus a consequence of a major change in pigeon ecology that they took over major Western cities. More precisely, the growth of urban pigeon populations through the colonization of a novel environment could be viewed as the result of an 'ecological fitting' (Agosta and Klemens 2008, 258 Janzen 1985) process, favored and triggered by various favorable factors: a large amount of food on city streets and marketplaces, numerous nesting sites in buildings, increased

farming productivity with surpluses of grain (Johnston and Janiga 1995), and the high annual reproduction rate of the pigeons that had been selected during their former domestication. Important urban populations of pigeons developed all over Europe during this period (for example, in Hamburg, where the number grew from three nests in 1901 to 3,000 individuals in 1938 and 20,000 in 1963). In the 1960s, their numbers were estimated to be 100,000 in Munich (Germany), 60,000 in Turin (Italy), 200,000 in Vienna (Austria), and 8,000 to 10,000 in Nuremberg (Germany); the same tendency also occurred in the United States (de Planhol 2004). However, quantitative data on pigeon numbers were not always available and led to frightening speculations. For instance, during a city council meeting in Paris in 1969, the pigeon population was estimated to be one million (Bulletin Officiel Municipal de la ville de Paris 1969) without any census (Baud and Brugère 1995); this estimation has since proven to have been excessively exaggerated (Vacher 1970).

Claims about the nuisance caused by pigeon droppings in cities began to be expressed as early as the 1930s and 1940s in journal articles in Europe and overseas (Givois, unpublished data; Jerolmack 2008). Complaints that pigeon feces were dirtying and harming historical buildings and monuments became common in French newspaper articles in the following decade (Givois, unpublished data). The ambiguous discourse between the promotion of pigeon breeding on the one hand and the critics on the other hand reveals the growing division occurring between captive domestic pigeons and feral urban pigeons. However, no public measures against pigeons were undertaken before the 1950s, most likely because of their status as a human auxiliary: it was previously a criminal offense to harm pigeons as they could be someone's property (Renauldon 1765; Charriaut 1870). However, in 1955, urban pigeons were legally declared *res nullius*, that is, ownerless, belonging neither to the city of Paris nor to any local authority (Bulletin Officiel Municipal de la ville de Paris 1955). Public opinion regarding pigeons encountered a turning point when they became associated not only with overcrowding, defecating and dirtying monuments, statues and buildings but also with carrying viruses and diseases. In particular, the discovery of the bacterium *Chlamydia psittaci* (Eb 1993), which can potentially cause pulmonary problems, was relayed by a 1952 article that claimed that 70% of

pigeons in Paris were carrying the disease (Lépine 1952). These scientific data raised debates about pigeons as a threat to humans, comparing pigeons to ‘rats with wings’ (Jerolmack 2008).

In France, feeding of urban pigeons in the outer realm became prohibited by law in 1966 (Vacher 1970), more or less at the same period as in other Western cities. At the same time, urban pigeon populations started to be controlled by trapping, poisoning, shooting, gassing, and so on (Haag-Wackernagel, 2002; Jerolmack 2008).

These anti-pigeon measures occurred during the emergence of a wide-reaching, hygienist conception of the modern city in the twentieth century in Europe and the United States (Hodak 1999; Leblanc 2003), that is, ‘orderly and sanitized, with nature subdued and compartmentalized’ (Jerolmack 2008:72). This hygienism was explained as a reaction to the massive arrival of animals and to ever-growing cities with proportionately increased city dweller requirements in terms of consumption of animal products at the end of the nineteenth century. Entire herds of animals were brought to the city daily, crammed together in the streets, to be slaughtered and quartered, often in open sheds. The exhibition of bloody carcasses on the butchers’ façades; the boom of tanneries; the multiplication of horses, dogs, and cats, and thus, the omnipresence of manure, excrement, and urine; the development of maggots; smells of industrial processing of animal products; and the violent sight of animal mistreatment resulted in the creation and intensification of an olfactory and sonic world (Baratay 2009). The unceasing coming and going of animals provoked chaotic traffic, especially on market days, and exhausted animals and hastily trained drivers caused increasingly more incidents. Poultry and rabbits were raised in humble families’ households, whereas cows and goats, which were kept in the numerous urban barns, wandered around daily to provide people with fresh milk (Baratay, 2009). Complaints, increased conflicts between animal users and others in their neighborhood, as well as growing attention to sanitary and hygienist concerns forced municipalities to intervene (Baratay, 1998). Programs of urban renovation were launched at the end of the nineteenth century, which cleaned up the city and pushed slaughterhouses to the fringes. This redevelopment of the urban landscape not only included larger streets and squares but also

vegetation, instead of animals, as a structuring element of urban space, as well in an aesthetic aim to clean up the air (Leblanc 2003).

In parallel, pigeons held no more functional utility in the beginning of the twentieth century, after their breeding was, to a great extent, abandoned. Pigeon fertilizer was supplanted by the expansion of chemical fertilizer, which began at the end of the nineteenth century (Déhérain 1892; Lagrue 1897) and increased after World War II with the modernization and the development of large-scale agriculture (Prévost 2006). The annual delivery of pigeon meat decreased in France from 209 to 67 tons between 1973 and 1979, in favor of the extensively grown chicken, because larger fillets were requested (Royer 1983). The use of pigeons as army messengers also became obsolete after the end of World War II. Pigeons did not even have a function as a moral guide when the Christian religion progressively abandoned its symbolic bestiary from 1930 to 1950 as a consequence of its internal evolution. Animals have indeed been stripped of their religious functions in an attempt to break with rural connotations and to humanize, rationalize and adapt religion to urban life (Baratay 1994).

However, new behavioral particularities observed in urban pigeons could have induced the erosion of their former moral function. First, as with other Columbidae, pigeons feed their young with crop milk and they can reproduce throughout the year as soon as adults can obtain enough food (Johnston and Janiga 1995). Thus, urban pigeons can reproduce throughout the year (with lower reproduction in winter, Jacquin et al. 2010), which led to them becoming a symbol of hypersexuality and debauchery rather than chastity or other moral values, in a secular society. Second, the alimentary behavior of urban pigeons changed from seed-eating behavior to an omnivorous diet (Johnston and Janiga 1995): although they originally fed on seeds found in the fields (Richelet 1680; Diderot and D'Alembert 1751), they switched to foraging on society's waste in the urban context. By continuously walking on the city ground, pigeons stand in opposition to the upstroke of birds and so have broken their symbol of elevation. In a French doctoral thesis in 1970, they were even labeled as 'pigeons de sol', literally 'ground pigeons' (Vacher 1970). As scavengers, pigeons became the

incarnation of the ordinary, if not mediocrity, in contradiction to their supernatural aspect (bright whiteness, extraordinary behavior, and sudden appearance) and their higher condition in religious imaginary.

IV. DISCUSSION

IV.1. (De)domestication: the (un)structuring principle

The redefinition of pigeons as a nuisance species is historically related to discourses about hygiene and the dirtiness of pigeons. Referring to Douglas' definition of dirt as 'matter out of place', there is no absolute dirt and, 'Eliminating it is not a negative movement, but a positive effort to organize the environment,' (Douglas 1966:2). We propose that pigeons' dirtiness was related to the broader social dynamic of the redefinition of space underlying the emergence of the hygienic city. By delineating the spaces allocated to animals and those reserved to human beings, these so-called 'imaginative geographies of animals' (Philo and Wilbert 2000:11) determine the acceptance or discomfort and rejection when animals transgress the lines imposed on them and therefore become constructed as nuisance animals (Jerolmack 2008). Following this proposition, pigeons were deemed as disturbing and polluting because they were considered not in their right place. Spatial relations between animals and society are thus decisive for the human interpretation of animal and pigeon representations as nuisances and, in this regard, are grounded on a deeper 'cultural and spatial logic' (Jerolmack 2008:72).

What is crucial here is that this spatialization, that is, what is or is not the appropriate place for animals, depends on the animal's status, defined by religious, public, legal, or scientific authorities, based on the contemporary cultural categorizations of animals (Vourc'h and Pelosse 1993). In Western societies, animals are mostly categorized as either "wild" or "domestic". In France, the deep roots of this classification can be traced back to the seventh century CE with the encyclopedists Isidore de Séville (Etymologies, in Voisenet 2000) and Raban Maur (De Natura rerum 842–847, in

Voisenet 2000). They were consolidated thereafter over centuries in encyclopedias and treatises of natural history (Vourc'h and Pelosse 1993), including the famous zoologist Buffon in the eighteenth century who rejected the nomenclature of animals following morphological criteria elaborated by Linneus at that time (Vourc'h and Pelosse 1993). Urban pigeons, however, do not belong to any of these categories; they are 'in between'. Indeed, as they went through domestication, urban pigeons differ from their wild ancestors, the rock dove *Columba livia*, with respect to their genetic and behavioral characteristics (Sol 2008). This is common among all domesticated species. The problem in urban pigeons is that because they are living feral, settling, feeding, and mating freely, they are no longer domesticated (de Planhol 2004). In France, this was reflected in their lack of legal status. Laws on wild animals apply to specific legal classifications of 'wild' animals, protected species, species that can be hunted, and so on, whereas laws on 'domestic' animals apply only through ownership (Vacher 1970).

Therefore, we argue that the reason for pigeons being out of place is that they belong to none of the common Western animal categories; more precisely, they no longer fit their former domesticated category. Hence, dirt and hygiene issues, as well as the perceived disturbance of pigeons, were grounded more deeply in their contesting of their domesticated status. However, what is at stake in this 'de-domestication'?

Anthropological studies have revealed that the wild-domestic distinction is not a universal organizing principal (O'Rourke 2000; Descola 2004). Indeed, domestication involves not only biological (Driscoll et al. 2009) but also cultural components (Russel 2002), from the production and use of animals to social organization and systems of representation (Digard 1988). Anthropological studies have provided valuable examples of the conceptions of hunter-gatherer and nomadic pastoral societies' regarding the species and spaces they use, transform, and live with, revealing that the wild-domestic distinction is not a universal organizing principal (O'Rourke 2000; Descola 2004). Even where these categories do exist, the domestic, the wild in general, and domestic and wild animals in particular

hold different connotations according to cultures and contexts. Although we acknowledge the wild-domestic dichotomy as a cultural construction, we will rely on it here as an anthropological category because it retains an analytical utility (Russel 2002; Orton 2010; Micoud 2010). The goal hence is not to provide a valid definition of domestication but rather to examine the representations related to it. Domestication is commonly recognized as difficult to define due to the variety of situations that cannot be neatly classified as wild or domestic. From a biological perspective, a domestic animal differs from its wild origin 'by its genetic composition and hereditary phenotype characteristics, including morphology and behavior, resulting from a long and deliberate human induced selective breeding' (O'Rourke 2000: 149); a domestic animal 'has [also] been bred in captivity, for purposes of subsistence or profit, in a human community that maintains complete mastery over its breeding, organization of territory, and food supply' (Clutton-Brock 1994: 26). From a socio-anthropological perspective, domestication 'can be said to exist when living animals are integrated as objects into the socio-economic organization of the human group, in the sense that, while living, those animals are objects for ownership, inheritance, exchange, trade,' (Ducos 1978: 54). Indeed, the term 'domestic' itself comes from the Latin term *domesticus* and literally means 'of the house' (*domus*, the house); it clearly denotes the act of making private (Digard 1990). Moreover, domestic animals are legally defined in French law as having a master (O'Rourke, 2000).

Both biological and socio-anthropological approaches share the aspect of human mastery on and use of domestic animal as resources: control exerted on movement and breeding, converting animals into property and goods as a food supply, product for industrial use, energy and labor force, and territory and herd defense (Delort 1984). The utilitarian aspect of domestication has expanded since the eighteenth century (Baratay 2009). Demographic and economic growth, together with industrialization and urbanization, strengthened the existing uses of domestic animals and brought new ones. The Industrial and Agricultural Revolutions increased the need for raw materials and a labor force to pull new machines, harvesters, and wagons. In addition, the boom of the textile industry exacerbated the demand for wool. Meat consumption was multiplied in some French cities

by seven during the nineteenth century, together with the consumption of animal by-products. The number of soap, oil, candle, leather, fertilizer, and perfume factories that used animal skin, bones, fat, and tendons increased considerably during that period (Baratay 2009). Considering domesticated animals mainly in utilitarian terms is even mirrored in the indifference of zoological sciences to the study of domesticated animals, which was relegated to disciplines such as veterinary medicine and zootechnics (the technology of animal husbandry) that were concerned with the improvement of animals to fulfill human needs (Digard 1992).

It was precisely these aspects of control and use that were lost when pigeons became feral. The alarmism regarding the number of pigeons could therefore be discussed in relation to the latent anxiety and public fear of the undominated presence of pigeons and thus a loss of control over pigeon reproduction and spread. At the same time, pigeons held neither functional utility, owing to the transformation and intensification of agriculture and the evolution of communication means, nor moral value with religion's modernization as well as the development of new behavioral traits of city-dwelling pigeons. Not only did they offer no more use for society but, as the ultimate 'provocation', urban pigeons started to use society by eating and living on human refuse. The French term for 'feral', *marrons*, is in this context particularly telling, as it has been taken over by an analogy to the pejorative designation of runaway slaves (Digard 1990). It is compelling that the loss of the former use and subordination was taken as the principal element to designate and define feral individuals with a negative connotation.

Given this historical and ecological framework, we propose that the understanding of pigeons as pests resulted from the dialectical relationship between changing social processes and pigeons' own agency in terms of ecological and behavioral traits. Hygiene issues were revealed to be a question of boundaries and space allocated to animals related to their status. In fact, the current representation of pigeons as disturbing reflects the underlying discomfort with animals that no longer comply with human control and no longer show utility to society. In other words, we argue that the socio-nature

of pigeons was produced in a human-animal network ordered by control and utilitarian relations of the first towards the latter. As pigeons went against the system rules, they became constructed as a nuisance species.

IV.2. The dominant anthropocentric paradigm

The structuration of the network has to be considered in the light of the nexus of power relations and dominant interests (Heynen 2006, Blaikie 1999). In light of Western ideas, it appears that the understanding of animals as subordinate and at service to human beings is a normative scheme relying on a dominant anthropocentric paradigm, which has been built and constantly renewed over time by the religious, intellectual, scientific, and public authorities, who had the cultural monopoly and the power to impose their schemes (Breakwell 1993).

In Western culture, the Judeo-Christian tradition is of particular importance to understanding the shaping and evolution of thoughts (Baratay 2010). In particular, the Old Testament is the basis of a representation of animals as being subdued and serving human beings (Delort 1984). In the biblical narrative of Genesis, Man, who was already made in God's image, is constituted king on earth and the master who received power over nature from God (Baratay 1995, Genesis 1:26). Even after the Fall, where Adam and his descendants lost their initial power over animals, it is restituted after the Flood: 'Everything that lives and moves about will be food for you. Just as I gave you the green plants, I now give you everything (Genesis 9:3).'

Beyond the established dualism of man and nature, it was presented as God's will that human beings should exploit nature and that everything in the physical Creation exists to serve their purposes (White 1967). However, feral animals go against the anthro-po-finality of Creation. To take up the religious imagery, it is as if animals, through their feral state, would make humans go through the Fall again.

The necessary connection between human dominion over animals with spiritual and symbolic human thought has already been highlighted as lying at the origins of animal domestication. 'Aside from "pet

keeping”, animal appropriation (that is, domination) is almost impossible in animist or totemic societies as in their ‘horizontal’, cosmogonic conception of the world they consider animals, plants and humans as existing within the same hierarchical level. In sharp contrast, to start the process of animal domestication [...] humans had to radically change their “horizontal” conception of the world into a “vertical” one. Humans were beginning to see themselves within a hierarchical order dominated by divinities, placing themselves above animals and plants, which in turn allowed them to dominate or even kill them,’ (Vigne 2011: 178).

The idea that animals were created with an anthropocentric finality has been transmitted through theology over the centuries. In the eighteenth century, Protestant and Catholic discourses affirmed that the horse had been created to carry human beings, sheep to provide them with wool, dogs as company, and so on. As Baratay (1998) observed, this was more than a unidirectional influence, but rather a continuous interaction between religion and society, with the latter using the former as justification for its customs.

These Judeo-Christian representations have been relayed using different authoritative currents of thought through scientific and philosophical justifications for animal subordination and use. In classical rationalism in the seventeenth century and in Descartes’ influential thesis of animals as machines, human rationality allowed human beings to emerge from the irrational, instinct-driven animal world. Conversely, animals were determined by inherited biological laws. In this dualist world view, human beings, who are endowed with reason and self-awareness, have transcended nature; they thus have prerogative over the mechanic driven animals (O’Rourke 2000). This theory allows for the limitless use of animals at a time when Western science was beginning to achieve World dominion and was attempting, scientifically and philosophically, to demonstrate man’s central position in Creation (Baratay 1995). Similarly, a key tenet of scholars of the Western Enlightenment, including Kant and Bacon, was also to affirm human separation from nature and its necessary mastery over nature (Van der Born 2007, Smith 2006). In much the same way, two centuries later, in the nineteenth century, the naturalist Geoffroy Saint-Hilaire defined the history of domestication as

that of the development of human power, through which human beings became dominant over the other species and would have added supplementary ones to those appearing at the Creation (Saint-Hilaire 1836). Though Darwin and other naturalists challenged the notion of the divine plan of the Creation, hierarchical patterns remained unchanged. Human beings might be animals, but only they possess rationality, language, consciousness, or emotions, which justified and also explained in terms of evolution their perceptions of inferiority and superiority (Mullin 1999, O'Rourke 2000). At the same time, in 1850, French legal authorities reasserted human domination over animals, when elaborating the first law for the protection of domestic animals (Loi Grammont) and selecting animal usefulness for human beings as the criteria for the application of the law (Pierre 2007).

Although alternative perceptions also existed, animal representations in utilitarian and control terms remained the dominant view during the colonial era in the eighteenth and nineteenth centuries, notably through zoological gardens, which were used as a privileged laboratory in the Western undertaking to domesticate wild fauna completely and to discover potentially new uses for them (Baratay 1998). Locked behind bars, they were presented as defeated and subdued, mirroring the colonial dream of overall dominion (Digard 1988; Baratay 1997). The appropriation of the wild was a window into the colonial enterprise in general, with zoo animals being a symbol for the colonized people (Hodak 1999).

More generally, it is indeed worth noting that domestication is an archetype of other forms of subordination and utilitarianism (Thomas 1984). The control and utilitarian relations in the domestication of animals at this period provided a domination model potentially extended to human beings, with inferiority criteria based on sex, ethnic or economic distinctions (for example, women, American Indians, Africans, the poor; see, Mullin 1999).

The remaining question here is what collective interests these moral and political institutions are powerfully protecting through their normative discourses on the human-animal hierarchy.

IV.3. I subdue, therefore I am

Our hypothesis is that human beings define themselves as a species precisely through their representations of utility and domination towards animals. Hence, they can define their own and unique place among, and above, the living. Representations of subdued animals can be viewed as a projection of human demarcation from and civilizing aspiration of their own natural state and mirror their interpretation of self as outside of animality. Because it is totally constructed by human beings, the city could be considered as the place par excellence for this self-definition.

Social representation theory (Moscovici and Hewstone 1983) conceptualizes identity as a location within representations, which would, beyond their cognitive and symbolic functions, include an identity function (Moloney 2010; Miguel et al. 2010). Sharing representations contributes to group identity formation because group members have a common 'world view' (Moscovici and Hewstone, 1983; Miguel et al. 2010). A reason driving the establishment of representations is here to assert and maintain a specific identity, as well as to valorize the group (Cohen-Scali and Moliner, 2008). The processes of identity formation, as implied in representations (Duveen 2001, in Breakwell 1993), takes place in contradistinction to the 'others', by defining the members of the group in respect to who they are not (Moloney 2010; Andreouli 2010). Thus, defined social identities are then credited with certain rights and duties (Andreouli 2010:14.3-5). By reflecting social rules and relations, social representations function as guides for action, which legitimize and orient behaviors, and justify and influence social relations (Miguel et al. 2010:23.3). The extent to which an identity and the representations related to it are shared within a group will thus also derive from the purpose they are serving and how significant it is for the group (Breakwell 1993). We use this theory in an extended sense compared with only human-human social representations, as we include non-human beings (animals, objects, and technologies) as constitutive of the social world (sensus, Latour 1993). As social identities can, in turn, shape the development of social representations through their acceptance and use (Breakwell 1993), it is thus precisely because pigeons continuously challenge

humans' definitions of themselves in relation to their utility and control towards animals and by resisting all the attempts to repel or kill them, and being, in all their uselessness and insubordination, so public, that pigeons are constructed as a nuisance species.

As public and intellectual authorities are, as we showed, essential in defining and perpetuating normative representations of proper human-animal relations, we can consider that it is precisely the Western dominant paradigm that delineates human identity specifically in its utilitarian control in relation to animals. Indeed, animal exploitation constituted a very important turning point in human history, starting with the transition from hunting and gathering to farming and food production during the Neolithic Revolution. These new human behaviors were accompanied by changes in settlement patterns, demography, social organization, or technology and allowed the development of most of what is considered human culture today (Crabtree 1993; Driscoll et al. 2009). We could, however, hypothesize further that by anchoring animal domination and use in human identity, the Western dominant paradigm makes animal exploitation an intrinsic in human identity rooted right and ensures as a consequence its social acceptance. Indeed, within a set of norms, beliefs and practices, it is much easier for everyone to adhere to the established pattern than to make changes. This dynamic can be linked to the overall externalization of nature in capitalist societies. Indeed, 'it is much easier to rationalize the profit-driven rape of earth and body alike if that nature is objectified' (Smith 2006:xiii).

V. CONCLUSION

In each historical period, pigeons were as much a vehicle for the creation and maintenance of social systems as they were a product of those systems. As soon as they stopped complying with the normative network dynamics and the dominant paradigm of valorizing or depreciating animals based on their function and subordination towards humans, they were themselves reformed as a nuisance

species for the purpose of human identity construction. Through the pigeon example, we have shown that the concept of nuisance species relies on complex dynamics that, while certainly and definitely including the animals' ecological and behavioral characteristics (here, their abundance and foraging behavior in cities), also involves interactions with socio-political processes. This last aspect remains widely ignored when dealing with nuisance species in conservation issues. However, considering nuisance species as a type of socio-nature further allows turning the problem around; rather than a question of nuisance species, the current failure of the modern society to stop the biodiversity crisis despite such a high level of knowledge and power could be seen as being precisely grounded in the Western paradigm of environmental dominance and exploitation. Indeed, 'still today, terms such as "sustainable development" and "natural resource management" imply the imposition of human values on and control over living nature' (O'Rourke 2000: 147). In that case, (scientific) authorities should be conscious of and reflective on their role and impact and lastly their responsibility to the development and structure of present-day environmental stances.

ACKNOWLEDGMENTS

We would like to thank Professor Eric Baratay and Dr. Assaf Shwartz for helpful discussions and suggestions about this article, as well as two anonymous referees for their comments.

REFERENCES

- Agosta SJ, Klemens JA (2008) Ecological fitting by phenotypically flexible genotypes: implications for species associations, community assembly, and evolution. *Ecol Letters* 11:1123–1134
- Allys (1909) Le Pigeon dans l'Egypte Ancienne. *La Correspondance d'Orient* 12/1909:1053–1054
- Andreouli E (2010) Identity, positioning and self-other relations. *Papers on Social Representations* 19:14.1–14.13

- Baratay E (1994) Les Controverses Contemporaines sur le Statut de l'Animal. L'Exemple de l'Eglise Catholique, France, 1940–1990. *Revue d'histoire moderne et contemporaine* 41(3):499–514
- Baratay E (1995) Zoologie et Eglise catholique dans la France du XVIIIe siècle (1670–1840): une science au service de Dieu. *Revue d'histoire des sciences* 48(3):241–266
- Baratay E (1997) Un Instrument Symbolique de la Domestication: Le Jardin Zoologique aux XIXe-XXe Siècles (L'Exemple du Parc de la Tête d'Or à Lyon). *Cahiers d'Histoire* 3–4, L'animal domestique, pp 677–706
- Baratay E (1998) L'Anthropocentrisme du Christianisme Occidental, In: B. Cyrulnik (ed.), *Si les lions pouvaient parler. Essais sur la condition animale*, Gallimard, Paris, pp 1428–1459
- Baratay E (2009) Le Grand Rapprochement. *L'Histoire* 338:78–87
- Baratay E (2010) Penser l'animal dans le catholicisme français contemporain (1940–2010). *Klesis Revue philosophique – Humanité et animalité* 16:201–2012
- Barot A (1891) *Leçons de Choses*. Alcan, Paris
- Baud C, Brugère H (1995) *Chiens et Pigeons en Milieu Urbain: Population, Pollutions, Solutions*. Thèse Méd. Vét. Alfort, Paris
- Bibliothèque Nationale de France (2013) Gallica bibliothèque numérique. <http://gallica.bnf.fr/>. Accessed 1 Nov 2011
- Blaikie P (1999) A review of political ecology. issues, epistemology and analytical narratives. *Zeitschrift für Wirtschaftsgeographie* Jg 43(3–4):131–147
- Blechman AD (2006) *Pigeons. The fascinating saga of the world's most revered and reviled bird*. Grove Press, New York
- Bois M (1847) *Le Nouvel Art d'Elever et de Multiplier les Pigeons*. Tissot, Paris
- Bonnery G (1909) *Pages Oubliées, Légendes et Traditions*. Monnoyer, Le Mans
- Bonnier G (1922) *Technologie: zoologie appliquée*. Les Fils d'Emile Deyrolle Editeur, Paris
- Bourguignon A (1882) *Volontariat d'un An. Agriculture*. Garnier Frères, Paris

-
- Breakwell GM (1993) Social representations and social identity. *Papers on Social Representations* 2(3):1–20
- Breteuil J (1860) *Le Cuisinier Européen*. Garnier Frères, Paris
- Brévans J (1892) *Le Pain et la viande*. Baillière, Paris
- Bulletin Officiel Municipal de la ville de Paris (1955). Paris
- Bulletin Officiel Municipal de la ville de Paris (1969). Paris
- Bulletin Technique du Génie Militaire (1936). Paris
- Castree N, Braun B (2001) *Social nature*. Blackwell, New York
- Chapin FS, III, Starfield AM (1997) Time lags and novel ecosystems in response to transient climate change in Arctic Alaska. *Clim Change* 35:449–461
- Charriaud F (1870) *Collection Générale des Lois et Décrets du Gouvernement*. Gouvernement de la Défense Nationale, Paris
- Clutton-Brock J (1994) The unnatural world: behavioural aspects of humans and animals in the process of domestication. In: Manning A, Serpell JA (ed) *Animals and human society: changing perspectives*. James Serpell, London, pp 23–35
- Cohen-Scali V, Moliner P (2008) Représentations Sociales et Identité: Des Relations Complexes et Multiples. *L'orientation scolaire et professionnelle* 37(4):465–482
- Colautti RI, MacIsaac HJ (2004) A neutral terminology to define 'invasive' species. *Divers Distrib* 10:135–141
- Conseil Général. Rapports et Délibérations (1893) Marne
- Conseil Général. Rapports et Délibérations (1894) Marne
- Conseil Général. Rapports et Délibérations (1903) Marne
- Conseil Général. Rapports et Délibérations (1926) Morbihan
- Conseil Général. Rapports et Délibérations (1934) Marne
- Conseil Général. Rapports et Délibérations (1902) Eure
- Corneille (1694) Pigeon. *Dictionnaires des 16^e et 17^e Siècles*. Huguet, Paris

- Courchamps M (1853) Dictionnaire Général de la Cuisine Française Ancienne et Moderne ainsi que de l'Office et de la Pharmacie Domestique. Plon Frères, Paris
- Crabtree PJ (1993) Source early animal domestication in the Middle East and Europe. *Archaeol Method Theory* 5:201–245
- Crespon J (1844) Faune méridionale ou Description de Tous les Animaux Vertébrés Vivans et Fossiles, Sauvages ou Domestiques [...] du Midi de la France. Editions Camariguo, Nîmes
- Davis MA, Chew MK, Hobbs RJ, Lugo AE, Ewel JJ, Vermeij GJ, Brown JH, Rosenzweig ML, Gardener MR, Carroll SP, Thompson K, Pickett STA, Stromberg JC, Del Tredici P, Suding KN, Ehrenfeld JG, Grime JP, Mascaro J, Briggs JC (2011) Don't judge species on their origins. *Nature* 474:153–154
- De Ferriere C (1741) Nouveau Commentaire sur la Coutume de la Prevoté et Vicomté de Paris. Chez Saugrin, Paris
- de Planhol X (2004) Le Paysage Animal. L'Homme et la Grande Faune: Une Zoogéographie Historique. Fayard, Paris
- Déhérain PP (1892) Amendements et Engrais : Engrais chimiques. In: Masson G (ed) *Traité de Chimie Agricole : Développement des Végétaux, Terre Arable, Amendements et Engrais*. Corbeil, Paris, pp 792–817
- Eb F (1993) Chlamydia psittaci : Epidémiologie, pouvoir pathogène et diagnostic. *Médecine et Maladies Infectieuses* 23 (12) : 919 – 924
- del Hoyo J, Elliott A, Christie D (ed) (2005) *Handbook of the birds of the world vol. 10*. Lynx Ediciones, Barcelona
- Delort R (1984) Les Animaux ont une Histoire. Editions du Seuil, Paris
- Descola P (2004) Le sauvage et le domestique. *Communications* 76:16–39
- Diderot D, D'Alembert J-R (1751) Pigeon. *Encyclopédie ou Dictionnaire Raisonné des Sciences, des Arts et des Métiers*. Le Breton Editeur, Paris
- Digard J-P (1988) Jalons pour une anthropologie de la domestication animale. domestication et représentations, *L'Homme* 108, Les Animaux, pp 27–58

- Digard J-P (1990) *L'Homme et les Animaux Domestiques*. Anthropologie d'une Passion, Fayard, Paris
- Digard JP (1992) Perspectives anthropologiques sur la relation homme-animal domestique et sur son évolution. In: Durand R (ed) *L'homme, l'animal domestique et l'environnement du Moyen Âge au XVIIIe siècle*. Paris, pp 21–27
- Douglas M (1966) *Purity and danger*. Penguin, London
- Driscoll CA, Macdonald DW, O'Brien SJ (2009) From wild animals to domestic pets, an evolutionary view of domestication. *Proc Natl Acad Sci U S A* 106(1):9971–9978
- Ducos P (1978) Domestication defined and methodological approaches to its recognition in faunal assemblages. In: Meadow RH, Zeder MA (ed) *Approaches to faunal analysis in the Middle East*, Peabody Museum Bulletins No. 2. Cambridge, pp 53–56
- Duveen G (2001) Representations, Identities, Resistance. In: Deaux K, Philoguène G (ed) *Representations of the Social*. Blackwell, Oxford, pp 257–270
- Elliott GP, Wilson PR, Taylor RH, Beggs JR (2010) Declines in common, widespread native birds in a mature temperate forest. *Biol Cons* 143:2119–2126
- Elton C (1958) *The ecology of invasions by animals and plant*. Methuen, London
- Falk-Peterson J, Bohn T, Sandlund OT (2006) On the numerous concepts in invasion biology. *Biol Inv* 8:1409–1424
- Favre J (1905) *Dictionnaire Universel de Cuisine Pratique*. Encyclopédie Illustrée d'Hygiène Alimentaire: Modification de l'Homme par l'Alimentation. Librairie Imprimerie des Halles et de la Bourse de Commerce, Paris
- Fazey I, Fazey JA, Salisbury JG, Lindenmayer DB, Dovers S (2006) The nature and role of experiential knowledge for environmental conservation. *Environ Conserv* 33(1):1–10
- Foy F (1845) *Manuel d'Hygiène*. Hachette, Paris
- Gayot E (1876) *Le Pigeon, Histoire Naturelle, Races d'Utilité et d'Amateurs, Reproduction, Education, Hygiène, Maladies*. Tomlin Press, Paris, Ecoles de Tir
- Gérardin L (1905) *Le Pigeon Messenger dit Voyageur au XXe Siècle*. O. Bornemann, Paris

- Giunchi D, Baldaccini NE, Soldatini C (2007) On the use of pharmacological sterilisation to control feral pigeon populations. *Wildlife Res* 34:306–318
- Guidez J (1969) Le Pigeon Voyageur. *Bibliothèque de Travail* 691:4–34
- Haag-Wackernagel D (2002) Feral pigeons: management experiences in Europe, in *Atti 2nd Convegno Nazionale sulla Fauna Urbana 'Specie ornitiche problematiche: biologia e gestione nelle città e nel territorio'*, Firenze, 10 giugno 2000, ARSIA e LIPU. Firenze. M. Dinetti, Regione Toscana, pp 25–37
- Henry Y (1981) Le colombier, un Signe Extérieur de Noblesse. *Essai sur les Colombiers en Bretagne. Annales de Bretagne et des pays de l'Ouest* 88(1):67–86
- Hermant P, Boomans D (1928) La Médecine Populaire. *Bulletin du Service de Recherches Historiques et Folkloriques du Brabant*, pp 43–45
- Heynen N, Kaika M, Swyngedouw E (2006) Urban political ecology. Politicising the production of urban natures. In: Heynen N, Kaika M, Swyngedouw E (ed) *In the nature of cities: urban political ecology and the politics of urban metabolism*. Routledge, London, pp 1–19
- Hodak C (1999) Les animaux dans la cité: pour une histoire urbaine de la nature. *Genèses* 37:156–169
- Hoüard D (1780) *Dictionnaire analytique, historique, étymologique, critique et interprétatif de la Coutume de Normandie*. Leboucher, Rouen
- International Union for Conservation of Nature (2013) Invasive species. http://www.iucn.org/about/work/programmes/species/our_work/invasive_species/. Accessed 1 Oct 2013
- Jacquin L, Cazelles B, Prévot-Julliard A-C, Leboucher G, Gasparini J (2010) Reproduction management affects breeding ecology and reproduction costs in urban feral pigeons (*Columba livia*). *Can J Zool* 88:781–787
- Janzen DH (1985) On ecological fitting. *Oikos* 45:308–310
- Jerolmack C (2007) Animal archeology: domestic pigeons and the nature-culture dialectic. *Qual Sociol Rev* 11(1):74–95

- Jerolmack C (2008) How pigeons became rats: the cultural-spatial logic of problem animals. *Soc Probl* 55(2):72–94
- Johnston RF, Janiga M (1995) *Feral pigeons*. Oxford University Press, Oxford
- La Fontaine J (1678) *Fables, Livres VII, VIII, IX*, 2011th edition. Hatier, Paris
- La Perre de Roo V (1877) *Le Pigeon Messager, ou Guide Pour l'Elève du Pigeon Voyageur et Son Application à l'Art Militaire*. Deyrolle Fils, Paris
- La Ville de Mirmont H (1894) *La Mythologie et les Dieux dans les Argonautiques et dans l'Enéide*. Hachette, Paris
- Lagrue C (1897) Engrais Chimiques. *Journal de Bayeux, Sommaires de leçon de Sciences, Hygiène et Agriculture du Bessin*. Bayeux, pp 62–67
- Latour B (1993) *We have never been modern*. Harvard University Press, Cambridge
- Leblanc N (2003) La place de l'animal dans les politiques urbaines. *Communications* 74:159–175
- Lépine P, Sauter V (1952) Sur l'infection des Pigeons Parisiens par le Virus de l'Ornithose. *Bull Acad Natl Med* 135:332
- Lings M (1986) *Le prophète Muhammad, sa Vie d'Après les Sources les Plus Anciennes*. Editions du Seuil, Paris
- Lowe SJ, Browne M, Boudjelas S (2000) 100 of the world's worst invasive alien species. IUCN/SSC Invasive Species Specialist Group (ISSG), Auckland, New Zealand
- Lunel B (1858) *Colombe*. *Dictionnaire universel des Connaissances Humaines*. Lacroix-Comon, Paris, France
- Marion L (2013) Is the Sacred ibis a real threat to biodiversity? Long-term study of its diet in non-native areas compared to native areas. *C. R. Biologies*: <http://dx.doi.org/10.1016/j.crvi.2013.05.001>
- Menon (1749) *La Science du Maître d'Hôtel Cuisinier, avec des Observations sur la Connaissance et Propriétés des Alimens*. Paulus du Mesnil, Paris
- Micoud A (2010) Sauvage ou domestique, des catégories obsolètes? *Sociétés* 2(108):99–107

- Miguel I, Valentim J-P, Carugati F (2010) Intelligence and its development: social representations and social identities. *Pap Social Representations* 19:20.1–20.33
- Minteer BA, Collins JP (2005) Why we need an ‘ecological ethics’. *Front Ecol Environ* 3(6):332–337
- Moloney G (2010) Articulating Social Representations and Identity through Process & Content. *Papers on Social Representations* 19:15.1–15.16
- Mooney HA, Mack RN, McNelly JA, Neville LE, Schei PJ, Waage JK (2005) Invasive alien species. Island Press, Washington, A new synthesis
- Moquin-Tandon A (1860) *Éléments de Zoologie Médicale, Contenant la Description des Animaux Utiles à la Médecine et des Espèces Nuisibles à l'Homme*. Baillière, Paris
- Moscovici S, Hewstone M (1983) Social representations and social explanations: from the ‘Naïve’ to the ‘amateur’ scientist. In: Hewstone M (ed) *Attribution theory: social and functional extensions*. Blackwell, Oxford, pp 98–125
- Mullin MH (1999) Mirrors and windows: sociocultural studies of human-animal relationships. *Annu Rev Anthropol* 28:201–224
- Nunez MA, Bailey JK, Schweitzer JA (2010) Population, community and ecosystem effect of exotic herbivores: a growing global concern. *Biol Inv* 12:297–301
- O’Rourke E (2000) The reintroduction and reinterpretation of the wild. *J Agric Environ Ethic* 13:145–165
- Orton D (2010) Both subject and object: herding, inalienability and sentient property in prehistory. *World Archaeology* 42(2):188–200
- Palliez L (1932) *Le Pigeon Voyageur. Son Origine, Description, ses Qualités, ses Aptitudes. Son Utilisation au Cours des Guerres Anciennes et Moderne*. G. Baratte, Lille
- Philo C, Wilbert C (ed) (2000) *Animal spaces, beastly places*. Routledge, New York
- Pierre E (2007) Réformer les relations entre les hommes et les animaux: fonction et usages de la loi Grammont en France (1850–1914). *Déviance et Société* 1(31):65–76

- Pimentel D, McNair S, Janecka J, Whitman J, Simmonds C, O'Connell C, Wong E, Russel L, Zern J, Aquino T, Tsomondo T (2001) Economic and environmental threats of alien plant, animal, and microbe invasions. *Agric Ecosyst Env* 84:1–20
- Prevost P (2006) *Les Bases de l'Agriculture*. Lavoisier, Paris
- Primack RB, Sarrazin F, Lecomte J (2012) *Biologie de la conservation*. Dunod, Paris
- Renauldon J (1765) *Traité historique et pratique des droits seigneuriaux*. Knapen, Paris, France
- Rengade J (1887) *Les Besoins de la Vie et les Eléments du Bien-être, Traité Pratique de la Vie Matérielle et Morale de l'Homme*. La Librairie Illustrée, Paris
- Reutter L (1916) Des remèdes d'Origine Humaine et Animale Prescrits au Temps des Romains en Europe (suite et fin). *Bulletin de la Société d'Histoire de la Pharmacie* 13:201–204
- Ribémont B (1992) Les Oiseaux Domestiques dans les encyclopédies médiévales: quelques exemples 'à la ferme'. In: *Proceedings of the Symposium L'homme, l'animal domestique et l'environnement, Nantes 22–24 October 1992*, R. Durand, pp 291–304
- Richelet (1680) *Colombe*. *Dictionnaires des 16^e et 17^e Siècles*. Huguet, Paris
- Robbins P (2007) *Lawn people. How grasses, weeds, and chemicals made us who we are*. Temple University Press, Philadelphia
- Royer B (1983) *Elevage du Pigeon de Chair*. du Point Vétérinaire, Maisons-Alfort
- Rupin E (1884) *Droit de Colombier*. *Bulletin de la Société scientifique historique et archéologique de la Corrèze*. Société Scientifique, Historique et Archéologique de la Corrèze, pp 314–321
- Russell N (2002) The wild side of animal domestication. *Soc Anim* 10(3):285–302
- Saint-Hilaire G (1836) *Acclimatation et Domestication des Animaux Utiles*. Entièrement Refondue et Considérablement Augmentée, 4th edition. La Maison Rustique, Paris
- Salo P, Korpimäki E, Banks PB, Nordström M, Dickman CR (2006) Alien predators are more dangerous than native predators to prey populations. *Proc Roy Soc B* 274:1237–1243
- Seastedt T, Hobbs RJ, Suding KN (2008) Management of novel ecosystems: are novel approaches required? *Front Ecol Environ* 6:547–553

- Smith N (2006) Foreword. In: Heynen N, Kaika M, Swyngedouw E (ed) *The Nature of cities: urban political ecology and the politics of urban metabolism*. Routledge, London
- Sol D (2008) Artificial selection, naturalization, and fitness: Darwin's pigeons revisited. *Biol J Linn Soc* 93:657–665
- Spalikowski E (1895) *Les Superstitions Médicales Normandes*. *Bulletins de la Société d'Anthropologie de Paris* IV(6):476–478
- Stuart SN, Chanson JS, Cox NA, Young BE, Rodrigues ASL, Fischman DL, Waller RW (2004) Status and trends of amphibian declines and extinctions worldwide. *Science* 306:1783–1786
- Swyngedouw E (1999) Modernity and hybridity: nature, regeneracionismo, and the production of the Spanish Waterscape, 1890–1930. *Ann Assoc Am Geogr* 89(3):443–465
- Swyngedouw E (2004) *Social power and the urbanization of water*. Oxford University Press, Oxford
- Thiébaud de Berneaud A (1841) *Nouveau manuel complet du cultivateur français, ou l'Art de bien cultiver les terres, de soigner les bestiaux*. Roret Editeur, Paris
- Thomas K (1984) *Man and the Natural World*. Penguin Books, Harmondsworth
- Vacher M (1970) *Les Pigeons de Paris. Réductions du Nombre de Pigeons dans Paris, Ses Problèmes, Essais d'un produit Chimique Inhibant la Ponte chez le Pigeon*. Thesis Ecole Nationale Vétérinaire Alfort, Paris
- Valéry L, Fritz C, Lefeuvre JC, Simberloff D (2008) In search of a real definition of the biological invasion phenomenon itself. *Biol Inv* 10:1345–1351
- Valéry L, Fritz H, Lefeuvre JC, Simberloff D (2009) Invasive species can also be native. *Trends Ecol Evol* 24:585
- Valette R (1910) *Leçons de Choses. Enseignement Primaire, Classe de huitième*. H. Paulin, Paris
- Van der Born RJG (2007) *Thinking nature. Everyday philosophy of nature in the Netherlands*. PhD thesis Radboud Universiteit Nijmegen
- Van der Linden CG (1950) *Le Pigeon Voyageur*. Paris
- Viard A (1851) *Le Cuisinier National de la Ville et de la Campagne (ex-Cuisinier Royal)*. G. Barba, Paris

- Vigne J-D (2011) The origins of animal domestication and husbandry: a major change in the history of humanity and the biosphere. *Compte-Rendus Biologies* 334:171–181
- Voisenet J (2000) Bêtes et Hommes dans le monde médiéval. Le Bestiaire des Clercs du Ve au Xlle siècle. Brepols, Turnhout
- Vourc'h A, Pelosse V (1993) Du bestiaire au paysage: (Ré)introduire des espèces animales. *Études rurales* 129(130):51–58
- Vuorisalo T, Lehtikoinen E, Lahtinen R (2001) History of domestic and feral pigeons (*Columba livia*) in Finland before 1900 AD. *Ornis Fennica* 78:119–126
- Wallace RL (2003) Social influences on conservation: lessons from US recovery programs for marine mammals. *Conserv Biol* 17:104–115
- Warren CR (2007) Perspectives on the alien versus native species debate: a critique of concepts, language and practice. *Progr Hum Geogr* 31:427–446
- White L (1967) The historical roots of our ecologic crisis. *Jr. Science, New Series* 155(3767):1203–1207
- Wilcove DS, Rothstein D, Dubow J, Phillips A, Losos E (1998) Quantifying threats to imperiled species in the United States. *Bioscience* 48:607–615

CHAPTER 3

Anchoring the 'Pigeon Paradox': How Public Context Mediates

Interactions with Ordinary Biodiversity

- - -

Greening the City and beyond ? Similar Orientations but Contrasted

Local Policies in Two European Capitals

CHAPTER INTRODUCTION

With the growing acknowledgement of human imprint on ecological and biodiversity degradation (Young et al. 2006), civil society as well as intellectual, scientific, and institutional stakeholders have progressively called for more environmentally friendly attitudes and simultaneously launched new conceptions of society-nature relations (Campbell 2010, Heynen 2006, Grimm et al. 2000, Wolch et al. 2000, Berkes and Folke 1998). As shown in the aforementioned example of the cultural conceptions of pigeons as pests, common nature representations may still echo the former conceptual splitting of humans from the rest of the living environment, from which the same stakeholders that are promoting new ways of thinking nature are not necessarily exempt. These diverging conceptions and values about nature are relevant to understanding people's reactions to and compliance with official biodiversity conservation measures and may threaten the legitimacy and effectiveness of new management strategies (Buijs and Elands 2013). Among these, two are increasingly prominent in the urban context: on one side, increasing people's interest in and bond with nature (Dunn et al. 2006, Miller 2005) to raise conservation awareness, and on the other side, restoring nature within the city through extensive management and encouraging spontaneous biodiversity (Rosenzweig 2003). These management strategies often disregard that individual relations to nature and to their immediate environment do not linearly depend on explicit communication and top-down, scientific-based policy (Buijs and Elands 2013). As argued in the introduction, these relations are rather built in manifold interactions among others with the stakeholders who are affected by the proposed management measures; they also depend on implicit discourses about nature provided by day-to-day urban environmental management (Mugerauer 2010, Robbins 2007, Herda-Rapp and Goedecke 2005, Moscovici 2000).

The following chapter aims to offer insights into these processes and to identify which regulatory or incentive based policies would engage citizens and which, on the contrary, undermine pro-environmental behaviors.

In the first manuscript, we address the issue of human-nature reconnection under the perspective of the human experience of urban biodiversity. As nature is a broad idea and an abstract entity, which is not easy to relate to specific entities within the environment, we examined, through an observational approach, behavioral interactions between city dwellers and urban pigeons commonly found in cities. We found that most people (mean: 85%) do not interact with pigeons. Further, interactions (either positive or negative) are context and age-dependent: children interact more than adults and the elderly, whereas people in tourist spots interact more than people in urban parks or in railway stations. This result suggests that the people interacting with pigeons are mostly tourists.

We interpreted these results in terms of social norms: the manner in which urban species are publicly portrayed and managed could provide a normative pressure to city dwellers, thus potentially inhibiting people's interaction with and securing their emotional distance from the direct environment.

In the second manuscript, we address the interconnections between the recent conversion to green cities and effective planning at the city scale. We showed that efficient institutional actions encouraging biodiversity in the urban setting should acknowledge that city-dwellers' environmental stances and acceptance of public measures depend on implicit as well as explicit factors, such as park planning and management. In a comparative study between Paris and Berlin, we investigated two manners of how general green planning is translated into public urban park management. Using a multiple research strategy, we analyzed both cities' strategies for biodiversity and landscape, conducted semi-directive interviews with park managers and employed direct observations on the design and management in thirteen parks. We explored nature representations of city-dwellers to illustrate the differences in both cities' management strategies.

Biodiversity strategies in both cities revealed two similar aims, i.e., increasing urban biodiversity and city dwellers' awareness; however, they highly contrast in their implementation, with high levels of

control and top-down process in Paris compared with Berlin. Accordingly, nature representations of city-dwellers differ between both capitals, but only in the nature-control willing (more present in Paris than in Berlin). Our results further support that instead of normative arguments, giving city dwellers more space with nature as well as participatory approaches and public involvement in environmental decision making are crucial for achieving ecologically beneficial landscapes that are also socially supported and sustainable.

MANUSCRIPT

**Anchoring the 'Pigeon Paradox': How Public Context Mediates Interactions
with Ordinary Biodiversity**

Zina SKANDRANI^{1*}, Lucie DANIEL¹, Lauriane JACQUELIN¹, Gérard LEBOUCHER², Dalila BOVET² and

Anne-Caroline PREVOT¹

Human Ecology (Submitted)

¹ UMR7204 CNRS –MNHN- Centre d'Ecologie et des Sciences de la Conservation (CESCO), Muséum National d'Histoire Naturelle, CP51, 55 rue Buffon, F-75005 Paris, France. skandrani@mnhn.fr, acpj@mnhn.fr

² Laboratoire d'Ethologie et Cognition Comparées (LECC), Université Paris-Ouest La Défense, F-92001 Nanterre Cedex, France. Gerard.Leboucher@u-paris10.fr, dbovet@u-paris10.fr

* Corresponding author

KEYWORDS: Nature reconnection; social norms; human-nature interactions; urban pigeons; urban ecology.

I. INTRODUCTION

Mitigated success in preventing increasing biodiversity loss has been explained in recent years partly by growing individual disconnection from nature (Pyle 2003). Pyle (1978) explained this “extinction of experience” in urban areas as a cycle beginning with homogenization of biodiversity through habitat transformation, leading to impoverished human relations to nature, which in turn are further followed by even poorer environments and deeper isolation from nature. In this context of people’s estrangement from nature, raising broad-based public support for biodiversity conservation may become difficult (Fuller and Irvine 2010). This is particularly prominent in cities (Miller 2005), where half of citizens worldwide are now living, a figure that is projected to reach 80% by 2050 (United-Nations 2011). Urbanites spend 90% of their time inside buildings (Evans & McCoy 1998) while nature-based recreation decreases (Pergams & Zaradic 2008).

Yet, besides formal environmental education, the success of conservation has been proposed to depend on people’s ability to experience biodiversity and maintain a direct connection with nature (Dunn et al. 2006). Indeed, individual’s environmental sensitivity is related to formative experiences during childhood (Kahn and Kellert 2002); strong and lifelong interaction with nature result lastly in higher conservation concern and environmental action (Lindemann- Matthies and Bose 2008, Chawla 1998, 1999).

Given the high proportion of humans living in or near cities, restoring these essential human connections with natural elements depends massively on urban species and ecosystems, which are in closest proximity to where people live and work (Grimm et al. 2008). To improve environmental awareness among urban citizen, interaction with ordinary everyday nature should therefore be highly encouraged (Prévot-Julliard et al. 2011). In most Western cities however, urban biodiversity is partly composed of species which have often negative cultural connotations, such as urban pigeons (*Columba livia*), House Sparrows (*Passer domesticus*), European Starlings (*Sturnus vulgaris*), cockroaches (*Blattaria*) and rats (*Rattus rattus*) (Dunn et al. 2006). These so-called “pest” species as

well as habitats such as cracks between sidewalks and underpasses are commonly categorized as scary, unhealthy, and bad (Jerolmack 2008). Interacting with these species as a way to open the door into a broader interest in wild nature appears therefore difficult and has therefore been termed the “pigeon paradox” (Dunn et al. 2006). Yet, these animal species are sometimes the easiest species to interact with, because of their abundance and/or familiarity with humans.

In this paradoxical context, the interactions of city dwellers with ordinary urban biodiversity may depend on several interrelated factors: the ecology of the species, but also individual characteristics of city dwellers (age, personal history: Hinds and Parks 2008), the context of the interaction (Blake 2001), social norms and public policies.

In the current paper, we studied city dwellers' interactions with a specific so-called “problematic” species present in the cities (Skandrani et al. 2014), the feral pigeon *Columba livia* in Paris (France), while most studies dealing with human-nature relationships in cities concentrate on plants (see Matsuoka and Kaplan, 2008). Urban feral pigeons are one of the most common animal species in many western cities such as New York, London, Basle, Barcelona or Paris and are easy to interact with (Blechman 2006). They are however described as disease vectors even though few cases of disease transmission from pigeons to humans are reported in scientific studies (Haag-Wackernagel and Moch, 2004), or as a source of nuisance for people (“flying rats”, Jerolmack, 2008). In these large cities, pigeon populations are often managed (Haag-Wackernagel 2002) and a general feeding ban has been implemented to reduce the birds' numbers (Colon and Lequarré 2013).

More precisely, we conducted a correlative field study using an observational approach to qualify and quantify human behavior in different contexts. We found that most people do not interact at all with nearby pigeons, and that most interacting people are children and tourists. We interpreted our results in terms of social normalization of individual behaviors toward urban biodiversity.

II. MATERIALS AND METHODS

II. 1. Data collection

We studied interactions between humans and pigeons in six (6) different places in Paris (France): two railway stations where city dwellers only pass through (Gare Montparnasse and Gare de Lyon), two urban parks that city dwellers use (Parc Montsouris and Jardin des Plantes) and two tourist spots where city dwellers and tourists coexist (Notre Dame and Beaubourg). In each site, we focused our attention on a particular group of 5-20 randomly chosen pigeons and noted the behavior of people passing close to the flock.

Each sampling period lasted 2 hours, and was repeated 9 times in each site: 3 times in the morning (8:30-10:30), 3 times in the middle of the day (12h:00-14:00) and 3 times in the afternoon (15:00-17:00). All observations took place during week-days. The data was collected from late April to late May 2010, which was not a holiday period for Parisians, and when tourists were present but not predominant.

Observations were conducted using the scan sampling method (Altman 1974): we first defined 12 possible human behavior patterns towards pigeons, in a preliminary study (Table 1). Then, every 10 minutes during every 2-hour sampling period (i.e., 12 scan samplings per 2-hour sampling period), we scanned the behavior of the group of individuals present close to the pigeon flock and classified their behavior according to the 12 pre-defined behavioral categories. During the scan, people were also visually classified by gender and into three age groups: children (0-15 years old approximately), adults (16-60 years old approximately) and elderly people (more than 60 years old).

II. 2. Definition of behavior types

After collecting the data, we summarized the 12 pre-defined behavioral categories into 4 behavior types: neutral – positive – negative – other (see Table 1). Neutral behavior was defined as individuals passing by or standing next to the group of pigeons without any interaction occurring. Positive

behavior was defined as individuals who looked at the pigeons, walked quietly towards them, showed an interest in them or fed them. Negative behavior was defined as individuals either scared of the pigeons or trying to scare them. We defined a final a category called 'other non-neutral' for individuals walking around the group of pigeons and trying to dodge them, and for whom we were not able to distinguish between a negative (fright/disgust) or positive interaction (taking care not to disturb them). Similarly, we referred as 'other non-neutral' people (mostly children) who ran towards pigeons with gesticulations, because this could be based either on positive feelings (interest and play) or negative feelings (trying to scare the pigeons).

In the subsequent analyses, we calculated the total number of interactive behavior occurrences as the sum of the respective numbers of positive, negative and other non-neutral behavior occurrences. We then calculated the proportion of interactive behavior occurrences as equal to the number of interactive behavior occurrences divided by the total number of behavior occurrences (neutral and interactive).

II. 3. Statistical analyses

We first compared the proportions of neutral behavior occurrences among the three types of sites, the two genders and the three age categories, by using a mixed ANCOVA model for binomial data with the proportion of neutral behaviors as a dependent variable and the site types, age-classes and genders as fixed effects (Pinheiro and Bates 2000). We controlled for the non-independence of data collected several times on the same site by including the site as a random factor in the model.

For non-neutral behavior, we then compared the proportions of positive and negative interactions for the same factors, using similar mixed models. For this analysis, we did not take the "other non-neutral" behavior types into account.

We compared the models by using Akaike Information Criterion (AIC), with two models being considered as significantly different whenever the difference in AIC values ΔAIC for the two models

was higher than 2. We then tested the significance of each effect in the best model with a Student comparison with 0.

All the statistical analyses were done on R software (R-Development-Core-Team 2010), with the package lme4 (Bates et al. 2014)

III. RESULTS

III.1. Proportion of neutral and interactive behaviors

We counted many more instances of neutral behavior than interactive behavior in all the situations: the percentage of neutral behavior averaged 81.6%, with a distribution “décalée vers le 1” (first quartile: 0.74 – last quartile: 0.95, Figure 1). This first result indicates that the great majority of the people encountered did not interact with the pigeons at all.

In more details, the proportion of neutral behaviors towards pigeons did vary between age categories, genders and locations (Table 1). If elderly people are more neutral towards pigeons than adults, children are much less neutral in their behaviors than both adults and elderly people (Figure 2). According to gender, men and women do not differ in their neutrality towards pigeons except for children: boys are significantly less neutral than girls (Table 1). Finally, according to locations, the proportion of neutral behavior was significantly lower in the tourist spots than in either railway stations or urban parks (Figure 3).

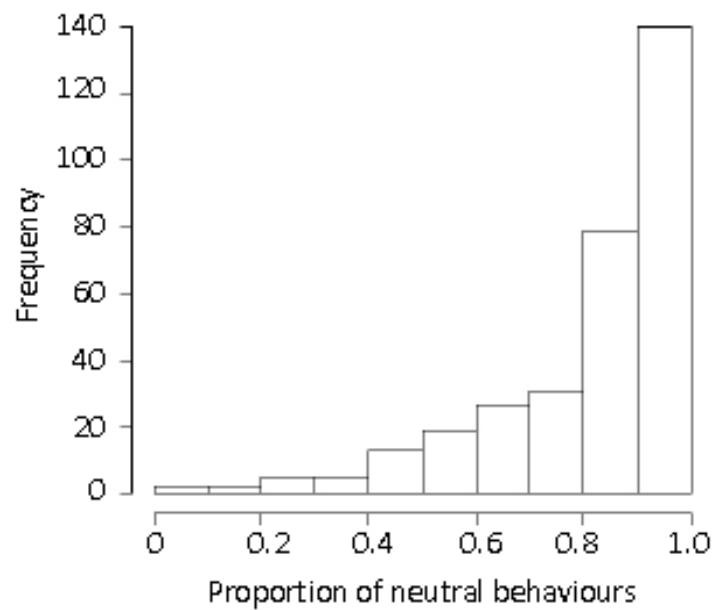


Figure 1. Distribution of the proportion of neutral behaviours towards pigeons in raw data of observation data

Explaining variable	Estimate (standard error)	P-value
Age – children	-1.13 (0.07)	$<10^{-10}$ ***
Age – elderly	0.25 (0.08)	0.002 **
Gender – men	0.03 (0.05)	0.55 NS
Children:men	-0.42 (0.09)	$2 \cdot 10^{-6}$ ***
Elderly: men	-0.15 (0.11)	0.17 NS
Location – urban park	-0.04 (0.18)	0.83 NS
Location – touristic places	-1.01 (0.17)	$5 \cdot 10^{-9}$ ***

Table 1: Variation of the proportion of neutral behaviours towards pigeons with gender, age and locations. The reference states of variables are as follows: railway station for location; adults for age; women for gender.

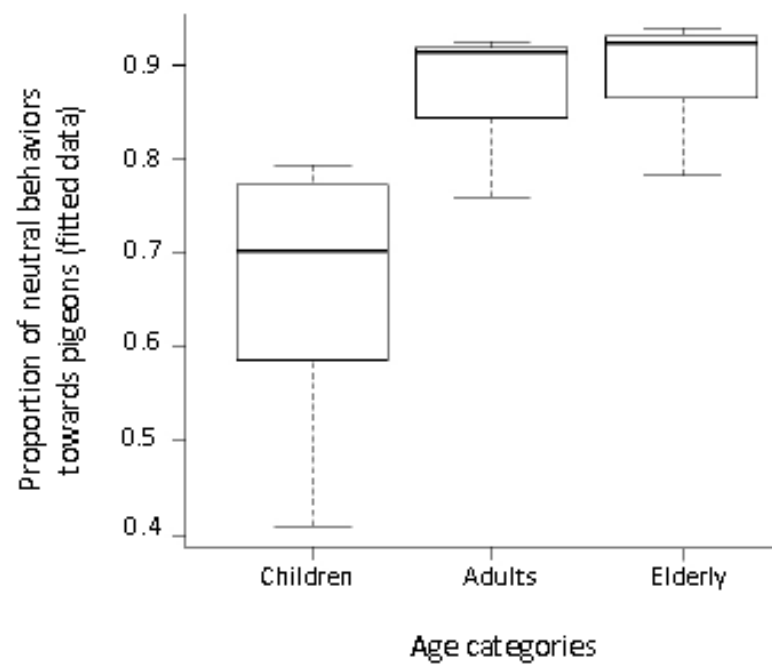


Figure 2: Different proportions of neutral behaviours towards pigeons for three age categories.

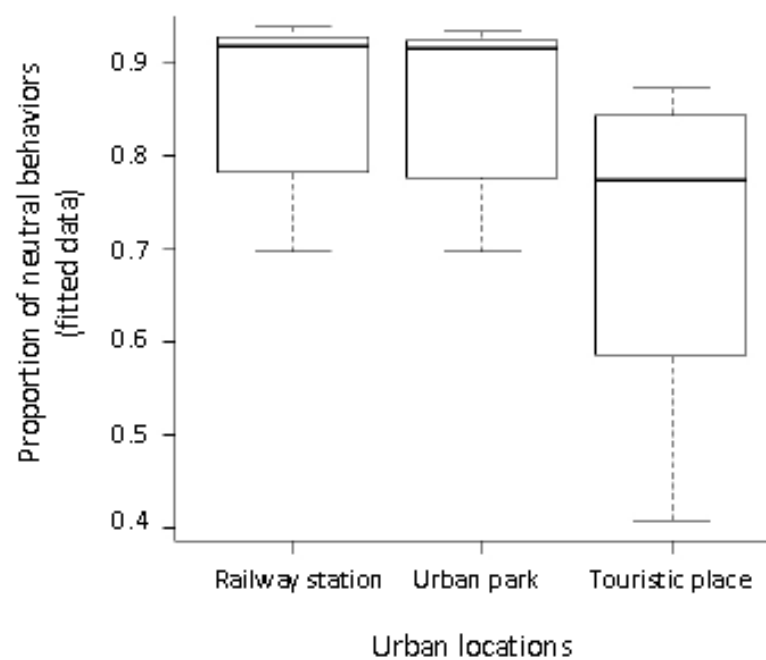


Figure 3: Different proportions of neutral behaviours towards pigeons in three categories of urban places.

III.2. Proportion of positive behaviors among interactive behaviors

Most interactive behaviors have been found as positive interactions: the mean proportion of positive behavior was equal to 92.0 % (first quantile at 89%; second quantile at 100%).

In more details, we did not find any significant difference in the proportion of positive behaviors among interactions between urban locations. However, the proportions of positive behaviors toward pigeons increase with age categories (Table 2, Figure 4). Finally, the influence of genders is more complex, young children having less positive interactions with pigeons although men have more positive interactions than women in general.

Explaining variable	Estimate (standard error)	P-value
Age - children	0.41 (0.21)	0.045 *
Age - elderly	1.02 (0.36)	0.004 **
Gender - men	0.57 (0.17)	0.0006 ***
Children:men	-1.37 (0.27)	2.10^{-7} ***
Elderly: men	-0.17 (0.54)	0.75 NS

Table 2: Variation of the proportion of positive interactions among interactive behaviors of people towards pigeons.

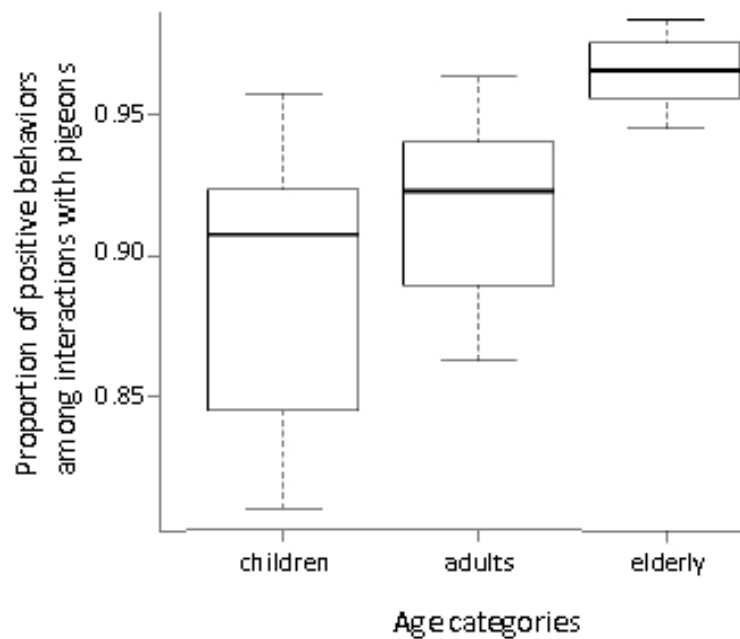


Figure 4: Proportion of positive behaviours among interactive behaviours, according to age categories

IV. DISCUSSION

The overwhelming predominance of neutral behavior towards pigeons is the first main result of this study. Most children, as well as adults and elderly people, do not interact with this species and do not seem to notice their presence close by when they walk through the city. The result that city dwellers do not interact with pigeons is in line with other studies that have already indicated that city dwellers do not interact with urban nature in general (Dunn et al., 2006; Pyle, 2003).

Moreover, when interaction did occur, positive interactions were much more frequent than negative ones. The latter result could be moderated by the way we classified the behavior types observed, when two behavior types (“other non-neutral behavior”, Table 1) were excluded from the analysis of positive vs. negative behavior. However, the instances of positive behavior (n=3142) were still much more numerous than the sum of so-called negative and “other non-neutral” behavior (n=696), making us confident with our results.

Concerning children, we found that children interact more with pigeons than older people, though their interactions were less positive than those of adults and the elderly, according to our classification. The higher proportion of positive behavior towards pigeons among elderly people could reflect the historical relationships that elderly people may have built up with urban pigeons: urban pigeons are descended from former domestic pigeons that were bred by many people, even in the cities (Skandrani et al. 2014). Older people in Paris may thus have bred pigeons in their childhood, or at least kept up a different cultural relationship with these species than younger people.

The proportion of interactive behavior was further context-dependent. Indeed, we observed significantly more interactive behavior towards pigeons in tourist spots than in either urban parks or railway stations, though there were no significant differences between sites according to the respective proportions of positive and negative interactions. This result was not expected, as we hypothesized that more interactions would occur in urban parks where wildlife is more likely to be

encountered. However, our surprising result suggests that people who interact with pigeons are tourists, and not local city dwellers.

The lack of interactions between people and pigeons could have been explained as the consequence of the birds' negative image. The latter result of higher interactions in touristic places challenges however this perspective as there is no reason to assume that Parisians hold worse perceptions about pigeons than tourists from other Western cities. The question is thus what difference in the touristic context may trigger this differential attitude.

The differences in interests towards pigeons, between children and adults or between touristic and non-touristic places, may first be interpreted in terms of mindfulness, that is the receptive attention to and awareness of present experiences (Brown and Ryan, 2003), characterized by a state of openness to novelty (Langer 1992). Though it has not been shown what encourages mindfulness in the touristic setting (Kang and Gretzel 2012), we may hypothesize that in the touristic context, since it differs from everyday live environment, individuals have higher heightened attention towards their nearly environment. In the same perspective, the higher interest of children towards pigeons may be explained by the higher curiosity of children towards nature (ref), or a higher empathy of children towards animals compared to adults (e.g. Kellert 2002).

However, and in addition to this individual-centered hypothesis, we hypothesize individual behaviors towards pigeons are also guided by internalized social norms that are explicitly or implicitly provide by injunctive messages towards pigeons from political authorities. Injunctive norms are rules and standards of approved and disapproved conduct in the shared view of societal members, which emerge from social interactions, legitimate authority or are legally established (Licht 2008, Cialdini 1995, Cialdini and Kallgren 1990). Besides individuals norms, commitments and beliefs (Cialdini and Goldstein 2004, Kallgren et al 2000), social norms do have a substantial impact on individual actions, including in environmental issues (littering, energy consumption, towel reuse in hotels) (Griskevicius et al. 2008, Schultz et al. 2007, Cialdini et al. 1990). In order to mobilise action against a social

problem, public service communicators hence often include normative information in their persuasive appeals (Cialdini et al. 2006). Further, the extent to which a norm addresses a public behavior also increases the degree of conformity (Cialdini 1995).

Concerning urban pigeons in Paris, local authorities provide for several years normative messages on pigeons: first, pigeon (and other bird species) feeding is forbidden in public space from 1966 (Vacher 1970), for health reasons (Colon and Lequarré 2013); large communication campaigns used to be provided in urban parks, with both information flyers and fines. Second, pigeon populations are controlled for long by local authorities: historically by captures of adult pigeons, more recently by pigeon houses and control of pigeon reproduction (Contassot 2007). Both feeding ban and so-called “contraceptive pigeon houses” provide normative messages to Parisian citizens, strongly suggesting that urban pigeons are too numerous, dangerous and maybe even up to “bad” species.

Under this perspective, the significant difference between children and adults in interacting with pigeons is plausible, as internalization of collective norms in the process of socialization, whereby individuals learn to follow rules of behavior in situations and accept to conform to particular values and norms in their conduct (Licht 2008, Persell 1990) only takes place in adolescence (Lehalle et al. 2004, Davis and Kandel 1981).

Of course, the potential role of norms as behavioral guides is moderated by situational factors. First, norms influence behavior only when they are activated, i.e. when the norm is made focal in consciousness at the time of the behavioral act (e.g. Cialdini et al 1990). If there is no salience, behavior will be largely unguided by normative considerations (Griskevicius et al. 2008, Cialdini et al 2006, Kallgren et al. 2000). Here, the pigeon avoidance norm invoked for local Parisians through printed messages all over the city, could be not primed for tourists who do not read french. Hence, even if familiar with similar social norms against pigeons in their home countries, tourists may be not focused on this norm in the touristic context. Second, the ability of norms to direct behavior is tied to conformity pressures: conforming to social norms is generally adaptive (through group cohesion or social affiliation), while deviating from the norm can lead to sanctions and social disapproval (Schultz

et al. 2008). Implicit in the concept of injunctive norms is the idea that if we engage in socially desirable conduct, others will approve us too (Cialdini and Goldstein 2004). This social validation is however only influential in generating norm-consistent action within an in-group and among similar others (Griskevicius et al. 2008, Cialdini 2005). In this context, tourists should be less affected in their decision-making by normative considerations since they are out-group members in Paris and not in presence of their own referent group or normative community. Individuals are in the touristic setting relieved of the primary costs of counter normative behavior e.g., social disapproval or becoming social outliers (Keenan 2008).

V. CONCLUSION

Our results showing higher rates of interaction with pigeons in children and in a touristic setting implies the existence of influence factors differentially affecting and restricting interactions with pigeons. We argued that a social norm for pigeon avoidance comes into play in everyday life for adults, that may however not always be activated, depending on situational factors, as for instance in the touristic setting.

The contextual pressures that result from public prescriptions such as the bird feeding ban may hold unintended but potentially inhibitory impacts on people's relation or at least the degree of interaction with urban biodiversity. In the light of the importance of interaction with ordinary biodiversity for the fate of nature conservation (Miller 2005, Prévot-Julliard et al. 2011), the costs and benefits linked to how we portray and manage non-native and so-called pestiferous urban species have thus to be carefully considered. Indeed, it is much more the indifference or lack of interest of city dwellers towards their ordinary natural surroundings that thwarts every attempt at education.

REFERENCES

- Altmann, J. (1974). "Observational study of behavior: sampling methods." *Behaviour* 49: 227-267.
- Bates D., Maechler M., Bolker B., Walker S. 2014. lme4: Linear mixed-effects models using Eigen and S4. R package version 1.0-6. <http://CRAN.R-project.org/package=lme4>
- Blake D. E., 2001. Contextual effects of environmental attitudes and behavior. *Environ. Behav.* 33, 708-725.
- Blechman A. D. 2006. Pigeons. The fascinating saga of the world's most revered and reviled bird. New York, Grove Press.
- Brown K. W. and Ryan R.M. 2003. The benefits of being present: mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology* 84(4): 822-848.
- Chawla L. 1999. Life paths into effective environmental action. *The Journal of Environmental Education* 31:15–26.
- Chawla L. 1998. Significant life experiences revisited: a review of research on sources of environmental sensitivity. *The Journal of Environmental Education* 29:11–21.
- Cialdini R.B., Demaine L.J., Sagarin B.J., Barrett D.W., Winter P.L 2006. Managing social norms for persuasive impact. *Social Influence* 1 (1): 3–15.
- Cialdini R.B. 2005. Basic Social Influence Is Underestimated. *Psychological* 16(4) :158–161.
- Cialdini R.B., Goldstein N.J. 2004. Social Influence: Compliance and Conformity. *Annu. Rev. Psychol.* 55:591–621.
- Cialdini R.B. 1995. Principles and techniques of Social influence. In A. Tesser (Ed.) *Advanced social psychology*. McGraw-Hill: New York: 256-281.
- Cialdini R.B., Reno R.R., Kallgren C.A. 1990. A Focus Theory of Normative Conduct: Recycling the Concept of Norms to Reduce Littering in Public Places. *Journal of Personality and Social Psychology* 58(6) :1015-1026.
- Contassot Y., 2007. La politique de la ville : pour une gestion durable des pigeons à Paris, in: *Bien vivre avec les animaux à Paris, le guide de l'animal en ville*. Mairie de Paris.

Colon P. L. and Lequarré N. 2013. Le nourrissage des pigeons dans la région parisienne. *Ethnologie française* XLIII: 153-160.

Davies M. and Kandel D.B. 1981. Parental and Peer Influences on Adolescents' Educational Plans: Some Further Evidence. *American Journal of Sociology* 87(2): 363-387.

Dearborn D. C. and Kark S. 2009. Motivations for conserving urban biodiversity. *Conserv. Biol.* 24: 432-440.

Dunn R. R., Gavin M. C., Sanchez M. C., Solomon J. N., 2006. The pigeon paradox: dependence of global conservation on urban nature. *Conserv. Biol.* 20: 1814-1816.

Evans G. W. and McCoy J. M. 1998. When buildings don't work: the role of architecture in human health. *Journal of Environmental Psychology* 18:85-94.

Ewert A., Place G., Sibthorp J. 2005. Early-life outdoor experiences and an individual's environmental attitudes. *Leisure Sci.* 27: 225-239.

Fuller R. and Irvine K.N. 2010. Interactions between people and nature in urban environments. In: Gaston, K. (Ed.), *Urban ecology*. Cambridge University Press: Cambridge. pp. 134–171.

Griskevicius V., Cialdini R.B., Goldstein N.J. 2008. Social Norms: An underestimated and underemployed lever for managing climate change. *International Journal for Sustainability Communication* 3: 5-13.

Haag-Wackernagel D. and Moch, H. 2004. Health hazards posed by feral pigeons. *J. Infection* 48, 307-313.

Haag-Wackernagel D. 2002. Feral pigeons: management experiences in Europe. *Atti 2° Convegno Nazionale sulla Fauna Urbana "Specie ornitiche problematiche: biologia e gestione nelle città e nel territorio"*, Firenze, 10 giugno 2000, ARSIA e LIPU. Regione Toscana, Firenze. M. Dinetti: 25-37.

Hinds J. and Sparks P. 2008. Engaging with the natural environment: the role of affective connection and identity. *Journal of Environmental Psychology* 28: 109-120.

-
- Jacquin L., Cazelles B., Prévot-Julliard A.C., Leboucher G., Gasparini J., 2010. Reproduction management affects breeding ecology and reproduction costs in urban feral pigeons (*Columba livia*). *Can. J. Zool.* 88, 781-787.
- Jerolmack C. 2008: How pigeons became rats: the cultural-spatial logic of problem animals. *Soc. Probl.* 55, 72-94.
- Kahn P. H. Jr, and Kellert S.R. 2002. Children and nature: psychological, sociocultural, and evolutionary investigations. Cambridge MA: M.I.T. Press.
- Kang M. and Gretzel U. 2012. Effects of podcast tours on tourist experiences in a national park. *Tourism Management* 33 : 440-455.
- Keenan P.J. 2008. Do Norms Still Matter? The Corrosive Effects of Globalization on the Vitality of Norms. *Van der Bilt Journal of Transnational Law* 41(2): 327-379.
- Kellert S.R. 2002. Experiencing nature: Affective, cognitive, and evaluative development in children. In P.H. Kahn, Jr. and S.R. Kellert (eds.), *Children and Nature: Psychological, sociocultural, and Evolutionary Investigations*, 117-151. Cambridge MA: The MIT Press.
- Langer E. J. 1992. Matters of mind: mindfulness/mindlessness in perspective. *Consciousness and Cognition* 1(3):289-305.
- Licht A. N. 2008. Social Norms and the Law: Why Peoples Obey the Law. *Review of Law and Economics* 4(3) : 715-750.
- Lindemann-Matthies P. and Bose E., 2008. How many species are there? Public understanding and awareness of biodiversity in Switzerland. *Hum. Ecol.* 36: 731-742.
- Matsuoka R. H. and Kaplan R. 2008. People needs in the urban landscape: analysis of Landscape and Urban Planning contributions. *Landscape Urban Plan.* 84: 7-19.
- Miller J.R. 2006. Restoration, reconciliation, and reconnecting with nature nearby. *Biol. Conserv.* 127: 356-361.
- Miller J. R. 2005. Biodiversity conservation and the extinction of experience. *Trends Ecol. Evol.* 20: 430-434.

- Nespor J. 2000. School field trips and the curriculum of public spaces. *J. Curriculum Stud.* 32, 25-43.
- Özgüner H. and Kendle A. D. 2006. Public attitudes towards naturalistic versus designed landscapes in the city of Sheffield (UK). *Landscape Urban Plan.* 74: 139-157.
- Pandey P. D. 2003: Child participation for conservation of species and ecosystems. *Conserv. Ecol.* 7: r(2).[online] URL:<http://www.consecol.org/vol7/iss1/resp2>.
- Pergams O. R. and Zaradic P. A. 2008. Evidence for a Fundamental and Pervasive Shift Away from Nature-Based Recreation. *Proceedings of National Academy of Sciences of USA* 105:2295-2300.
- Persell C.H. 1990. Becoming a Member of Society Through Socialization. In *Understanding Society: An Introduction to Sociology*, 3rd ed. New York, NY: Harper & Row. 98-107.
- Pinheiro J.C., Bates D.M. 2000. *Mixed-Effects Models in S and S-PLUS*. Springer.
- Prévot-Julliard, A. C., Clavel, J., Teillac-Deschamps, P., Julliard, R., 2011. The need for flexibility in conservation practices: exotic species as an example. *Environ. Manage.* 47, 315-321.
- Pyle R. M. 2003. Nature matrix: reconnecting people with nature. *Oryx* 37: 206-214.
- Pyle R.M. 1978. The extinction of experience. *Horticulture* 56: 64–67.
- R-Development-Core-Team 2010. R a language and environment for statistical computing. R Foundation for statistical computing. URL: <http://www.R-project.org>. Vienna, Austria.
- Schultz P.W., Nolan J.M., Cialdini R.B., Goldstein N.J., Griskevicius V. 2007. The Constructive, Destructive, and Reconstructive Power of Social Norms. *Social Norms* 18(5): 429-434.
- Schultz P.W., Khazian A., Zaleski A. 2008. Using normative social influence to promote conservation among hotel guests. *Social Influence* 3:4-23.
- Stone D. 2006. Sustainable development: convergence of public health and natural environment agendas, nationally and locally. *Public Health* 120: 1110-1113.
- Turner W. R., Nakamura T., Dinetti M. 2004. Global urbanization and the separation of humans from nature. *Bioscience* 54: 585-590.
- United-Nations. 2011. *World Urbanization Prospects. The 2011 Revision*.

MANUSCRIPT

**Greening the City and Beyond? Similar Orientations but Contrasted Local
Policies in Two European Capitals**

Zina Skandrani^{1*} and Anne-Caroline Prévot¹

BioScience (Submitted)

¹ Centre d'Ecologie et des Sciences de la Conservation CESCO, UMR 7204 CNRS-MNHN-UPMC,
Museum National d'Histoire Naturelle, CP 51, 55 rue Buffon, F-75005, skandrani@mnhn.fr,
acpj@mnhn.fr

* Corresponding author

KEYWORDS: Urban green management; Human-urban biodiversity relations; Urban parks;
Sustainable cities; Capabilities.

I. INTRODUCTION

Ever-growing urbanization causes global habitat loss, fragmentation and biodiversity depletion (Standish et al. 2013). To cope this global environmental degradation, public stakeholders have explicitly integrated various environmental measures and biodiversity conservation in city planning in the last decades (Gordon et al. 2009). Biodiversity-friendly landscape management has thus increasingly resulted in the development of green infrastructure in urban spaces and the built environment in general (Özgüner and Kendle 2006).

The introduction of green infrastructure in urban planning goes back to the late nineteenth-early twentieth century, with Western cities' drive to improve public hygiene through the implementation of urban parks (Novarina 2003). In these projects of healthy modern metropolis, emphasis was also put on the esthetical contributions of nature to the design of urban space (Novarina 2003, Gandy 2006). Hence, if vegetation participated in urbanistic remodeling, it was under an horticultural normative model of order and cleanliness (Menozzi 2007). This perspective of a contained and domesticated nature is nowadays combined in city planning with ecological objectives. Indeed extensive management is now applied for an ecological maintenance of urban green spaces all over European cities (Standish et al. 2013, Menozzi 2007, Özgüner et al. 2006). These new management measures are prone to insure ecological networks and connections throughout the city (Colding 2007). Some of these measures promote local biodiversity, limit strict lawn maintenance in favor of meadows, avoid the use of chemical phytosanitary products, and do not clean undergrowth (SSUB 2012, SSUB 2011, DGALN 2012, MP 2011).

More than urban nature *per se*, this new perspective in urban green management wish also adress perceptions and appreciation of nature of city dwellers themwelves. Indeed, although there is an increasing interest in urban natural landscapes ('new biophilia', de Groot and van den Born 2003), people's aesthetic preferences come sometimes into conflict with ecological goals (Gobster et al. 2007, Özgüner et al. 2006). In Western metropolis, spontaneous plants have been for instance for long deemed undesirable, the presence of unmaintained, natural vegetation conferring therefore a

negative image to an area as being unkempt, untidy, valueless, uncomfortable, or even frightening (Menozzi 2007). On the contrary, public preference for more formal, ornamental urban nature is sometimes explained by the fact that urban citizens have been subjected to the neat and tidy approaches of flower beds and mown grass for some time (Özgüner et al. 2007), when ecological concepts such as biodiversity and ecological sustainability were not yet called up for the definition of aesthetic criteria in landscape management (Gobster et al. 2007). Hence, extensive management of urban green sometimes represents a source of public disagreement as it does not conform to these deep rooted urban criteria of order and cleanliness (Menozzi 2007).

Yet, urban ecological objectives are unlikely to last in anthropic landscapes if they do not meet people's acceptance (Hostetler et al. 2011). In this sense, the success of reintroducing nature in cities and achieving public support, thus strongly depends on particular actions devoted to city dwellers' reconnection to nature (Gustafsson 2013, Standish et al. 2013), notably through institutional communication and urban green management. Indeed, though individual perception and environmentally relevant behaviors are affected by individual factors (e.g., age, education, personal experiences, friends, family), they are also driven contextual ones such as physical or socio-cultural environment, as well as institutions (Shipperijn et al. 2010). Among these, policies fundamentally drive citizens' attitudes, perceptions and opinions (Grimm et al. 2000, Flynn and Goldsmith 1994), and this in two ways: explicitly, through official communication (poster campaigns, mass media etc.), and implicitly through normative activities such as education, design, current regulations, city planning and management (Gobster et al. 2007).

Though city planners are nowadays prone to develop strategies that align ecological goals and human perceptions (Gobster et al. 2007), the impacts of policies are often not monitored (Hostetler et al. 2011), giving thus no indication about the adequacy of the implemented measures. In this study, we aimed to test how public urban green management influences individual attitudes towards urban nature and asked which measures are most likely to support or impede such environmental connection.

To answer this question, we investigated the implementation of general urban green strategies into concrete management of urban green spaces in two European capitals, Paris (France) and Berlin (Germany). We first explored the general environmental policy of both cities. We then studied how biodiversity is explicitly and implicitly communicated through urban park planning and management, in both cities. We focused on urban parks, because they represent the main type of urban greenspace and constitute a privileged mean of institutional communication about nature. Indeed, “[w]hile human and environmental phenomena occur at widely varying scales, humans engage with environmental phenomena at a particular scale: that of human experience of our landscape surroundings” (Gobster et al. 2007: 959). Further, for many urban dwellers, opportunities for contact with nature are limited to their local park (Grimm et al. 2008, Jorgensen et al. 2002). These green infrastructures (Hostetler et al. 2011) are therefore sometimes strategically managed to enhance cities’ sustainability, by providing a range of services to both urban citizens and urban wildlife (Shwartz et al. 2014, Tzoulas et al. 2007). Urban parks contribute therefore to local and regional biodiversity conservation, while they offer humans free space for active to relaxing activities and bring nature education close to people (Milton 2002, Hague and Siegel 2002).

We then explored whether urban green planning in both cities is consistent with the urban nature perceptions of city dwellers.

II. METHODS

II.1. Study areas

We chose Paris and Berlin as case studies based on priorily observed differences in green space layout and recreation service offered to city dwellers in both cities, allowing thus to have more variety in the studied urban green strategies and management.

Paris

Paris' current physiognomy derives from major urban remodelling decided by Napoléon III and implemented by Baron Hausmann, for hygienist and security considerations after a cholera epidemic in 1832 (Choay 2000). This program was guided by purification and embellishment goals in favor of the capital's prestige but also to destroy insalubrious districts which constituted the capital's major revolutionary centers. The city has been therefore provided with green spaces at each of its cardinal points (the "Bois de Boulogne" and the "Bois de Vincennes") and most current Parisian parks were created precisely in this perspective (Vaquin 2006, Fig 1). These parks were designed following English and Chinese influences, and not anymore following the model of the "Jardin à la française" (French formal garden), with its typical symmetry and geometric plans, flower beds, straight lines of trimmed trees and hedges, and constrained vegetation illustrating the mastery of man over nature (Mension-Rigau 2000, Novarina 2003).

Nowadays, green spaces represent 23 % of the city's territory counting the proximate forests Bois de Boulogne and Bois de Vincennes and 11% of inner-Paris, for a total of 2,2 Million inhabitants (DGALN 2012).



Fig. 1. Parks and green spaces in Paris, © Wikimedia Commons

Berlin

Green planning became an integral part of the city development under Prussian King Wilhelm IV, when a new movement was initiated in 1840 to give recreation access to Berlin's growing population. This objective turned away from former park functions, i.e., representation space for the feudal society, and introduced the concept of "social" green (SSUB 2011). The first "Volkspark", i.e., Park "for the people" was for instance created in order to provide nature-disconnected city dwellers with space for leisure, sports and more generally health improving activities (SSUB 2011).

The "Jansen-Plan" (1910, further developed in 1929) conferred Berlin its current green design, consisting in a double green belt, e.g. a small and a larger green ring within and around the city, as well as two radial outlines (Fig 2) composed of gardens, meadows, Parks cemeteries, and forests. A series of further Volksparks were implemented to realize this green city structure (SSUB 2011).

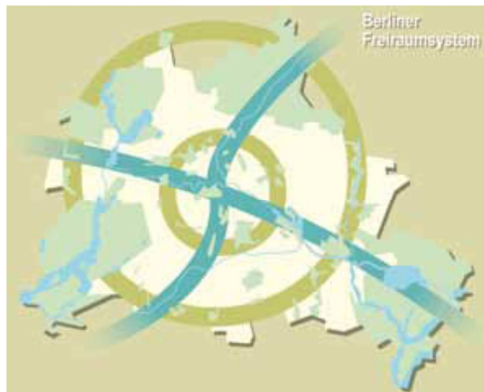


Fig. 2. Berlin Green Space System © Senatsverwaltung für Stadtentwicklung und Umwelt Berlin

With the fall of the German Democratic Republic (GDR) and Berlin's reunification in 1990, many public buildings, infrastructures, train rails, airport etc. were abandoned, and became free spaces for other uses. Hence, the 1994 adopted "Landscape and species conservation program" ("Landschafts- und Artenschutzprogramm") was implemented around 16 new urban parks on these areas to further complement and consolidate existing green structures and to compensate other building measures.

The most famous park belonging to this spatial development strategy is the “Mauer Park” along the former Berlin Wall (SSUB 2011).

Nowadays, green spaces cover 44 % of the city’s surface for a total of 3,4 Million inhabitants, (ratio of 26m²/inhabitant), with a majority of city dwellers having green spaces at maximum distance of 500m away from their home (SSUB 2011).

II.2. Description of the environmental strategies of Paris and Berlin

We conducted a thematic content analysis of both cities’ strategies for biodiversity and landscape in the form of action plans, the “Biodiversity Plan for Paris” (“Plan Biodiversité pour Paris” 2011, 76 p.), the “Strategy Urban landscape Berlin” (“Strategie Stadtlanschaft Berlin” 2011, 96 p.) and the “Berlin Strategy for Biological Diversity” (“Berliner Strategie zur Biologischen Vielfalt” 2012, 45 p.).

II.3. Assessment of urban park planning and management in Paris and Berlin

We conducted 8 semi-directive interviews with the managers of the studied 13 urban parks in both cities (7 in Berlin and 1 in Paris as parks, gardens and environment management is centralized). The managers were asked 30 questions addressing the management measures and the strategy they apply relatively to the park’s landscape features – management of the different strata, herbaceous, floral, shrubby, tree-filled, aquatic, mineral, and intervention on fauna – as well as to social dimensions of public welcoming in the parks (nature sensibilization activities, citizen involvement).

Then, we led park surveys in 13 urban parks in Paris (n=6) and Berlin (n=7). We sampled the explored parks based on their representativeness of the cities’ urban green and of different park implementation periods (from nineteenth century to after the 1990’, Table 1). Because Berlin parks (mean area: 55ha) were much bigger than Parisian parks (mean area: 12ha), we used a standardized protocole to assess parks’ architecture and design: we pre-defined on Google Earth 10 standardized

and consecutive transects of 100 meters (total: 1000 meters) in each park, that allowed to pass across all the park's different landscape types and atmospheres (lawns, woods, ponds etc.).

Then, in each transect, we reported common park landscape features situated at a distance of 50 meters – number of trimmed hedges, number of flowerbeds, number of lawns, number of lawns to which access is forbidden, number of meadows, number of benches and chairs, number of statues and fountains, number of natural ponds, number of concrete ponds, presence of grass on the pathways, presence of sports and playgrounds, presence of dog parks. We reported also management measures in the parks, such as the number of bans at the park entry, the presence of guards, and fencing (with closing hours) of the park area.

We statistically compared landscape features, management measures and bans in the parks of the two cities by using generalized linear models: with Poisson error for dependent variables that were numbers, and with binomial error when the dependent variable was presence/absence. Based on the numerous analyses on the same data, we applied a Bonferroni correction that set the significance at $P = 0.003$.

	PARIS	BERLIN
PARKS	<p>Parc Monceau (1857 ; 8,25 ha)</p> <p>Parc des Buttes Chaumont (1867 ; 24,73 ha)</p> <p>Parc Montsouris (1875 ; 15,5 ha)</p> <p>Parc de Belleville (1988 ; 4,5 ha)</p> <p>Parc de Bercy (1997 ; 14ha)</p> <p>Parc Martin Luther King (2007; 4,3 ha)</p>	<p>Grosser Tiergarten (1840; 210 ha)</p> <p>Treptower Park (Volkspark) (1888; 88,2 ha)</p> <p>Lietzenseepark (1914; 10,1 ha)</p> <p>Schäfersee Park (1928; 10,5 ha)</p> <p>Volkspark Hasenheide (1939; 47 ha)</p> <p>Görlitzer Park (1996; 14 ha)</p> <p>Spreebogen Park (2005; 6 ha)</p>

Table 1. Parks in Paris and Berlin studied relative to their planning and management

II.4. Non-random survey of city dwellers' representations in Paris and Berlin

We assessed in each city people's perceptions of urban biodiversity through a 15-item questionnaire (Appendix 2). We decided to administrate the questionnaire to people committed to the planning of urban space. Therefore, we contacted 30 neighbourhood councils in each city, formally implemented both in Paris and Berlin, and asked their participants to take part in the survey. As a result, a total of 62 individuals participated to the research on a voluntary basis. The sample size was prevalently constituted by women (60 %) and covered a large social background (employees, civil servants, executives, freelance professions, students, retired, unemployed) and age classes ranged from 22 to 81 year old (mean age: 52 year old).

The questionnaire design was inspired by de Groot and van den Born (2003) and Gustafsson (2013) and tried to asses a typology of four different visions of nature identified in environmental philosophy, from anthropocentric to ecocentric: (1) Nature to be contained (Mastery over nature), (2) Nature as commodity and ornament (Objectification), (3) Nature to be safeguarded (Stewardship), (4) Up close nature (Oneness with nature). We assume here that these views of nature reflect the degree of individual acceptance of spontaneous biodiversity as a result of urban extensive management, from the less to the most likely compatible view.

The questionnaire addressed in that purpose a broad range of issues, ranging from nature representations, perception of environmental features, environmental attitudes and emotions toward urban nature. The questionnaire include

ed twelve pre-coded questions, in which respondents were given a list of four possible answers corresponding to each view although in changing combinations (1, 3, 2, 4 or 2, 4, 1, 3 etc.).

Responses' format in these questions was closed, e.g. respondents were asked to choose only one of the four possible answers. They were then asked three yes-no questions about their contact with urban nature, their civic engagement for urban nature and their use of phytosanitary products in the private sphere.

We compared respondents' views of nature between both cities, using generalized linear models with Poisson error (GLM), by testing the respective effects of the following variables on the number of answers referring to the 4 pre-defined nature's visions: city, contacts with urban nature, civic engagement for urban nature and use of phytosanitary products.

III. RESULTS

III.1 General environmental strategies in Paris and Berlin

Paris : "Plan Biodiversité pour Paris"

The Biodiversity Plan for Paris (2010) derives from participative workshops on the management and conservation of Paris biodiversity, that have brought together city councillors with landscape professionals, associations, scientists and citizens. The action plan builds on the French National Strategy for Biodiversity defined in 2004 and sets as official objectives to reinforce the biodiversity on Paris territory and to stimulate a change in people's negative perception of urban animal and plant species, implying thus also a change in cultural representations and esthetic norms.

The content analysis identified two major action categories addressing these goals:

1/ An ecological dimension based on the reinforcement of ecological continuities at local and regional scales, a diversification of habitats for fauna and flora, the adoption of biodiversity friendly management measures, and the consideration of biodiversity in urban planning and policy. These actions include the further development of urban ecological network with the multiplication of the connections between a green belt situated around Paris and a small former railway belt within Paris and with adjacent communities, the realization of green bridges and green rooftops on municipal buildings and their promotion on private buildings, the conservation of spontaneous flora along the Seine river banks and extensive management of ring roads. This plan proposes to locate and manage interstitial spaces such as urban fallow land and vacant lots, in order to create temporary or perennial micro natural reserves within the city which are forbidden to the public.

2/ A social dimension based on knowledge transmission and public sensibilization to urban biodiversity and good practices. The further development of this sensibilization programm relies on a set of pedagogical actions, guided tours, conferences, workshops, exhibitions, a documentation center on Paris' biodiversity and habitats, all targeting to make city dwellers discover urban nature, to make ordinary biodiversity more attractive and to highlight its services and vulnerability to certain human activities. The plan encourages direct explanations from educators and public agents to city dwellers concerning new management protocols (extensive management of fallow lands, allowance of spontaneous vegetation in the streets), in order to let citizens accept and respect these spaces in their novel form. The plan also promotes scientific citizen science programs of voluntary biodiversity data collection, by considering these programs as a tool for a better public knowledge on urban biodiversity. These public awareness raising measures rely on the explicit expectation that "a pedagogical communication will allow a better understanding and thus a better acceptance of urban biodiversity and ecosystems " (Plan Biodiversité pour Paris, translation Z.S.).

Berlin: "Strategie Stadtlandschaft Berlin" – "Berliner Strategie zur Biologischen Vielfalt"

Both strategies have been elaborated in a participatory process in 2009-2011, the "Strategie Stadtlandschaft Berlin" through workshops with experts and associations and the "Berliner Strategie zur Biologischen Vielfalt" with representatives from scientific, economic, and citizen communities.

They are built on the German National strategy for biological diversity (2007) but put a stronger reference to urban habitats and actors, and are in continuity with former Berlin Landscape and biodiversity conservation programs from the 1990' (LAPRO "Berlin Landschaftsprogramm einschließlich Artenschutzprogramm").

The exposed objectives of the strategies are to reinforce, sustainably secure, and further develop urban biodiversity in innovative ways, by and for city dwellers, in order to enhance the positive perception and valuation of Berlin's green and cityscapes. These objectives ensue from the definition of urban green "as part of Berlin's identity", through its several dimensions as "ecological resource",

“cultural nature and heritage”, and “space for novel nature experiences”. In this, the strategies claim to be a mixed ecological and socio-cultural programm. Further, the Strategie Stadtlanschaft Berlin specifies from the beginning to be only as a joint project able to reach success.

As in Paris, the content analysis identified two twisted action categories addressing these objectives:

1/ Biodiversity conservation. Enhancing biodiversity and ecosystem services by expanding urban ecological network and further linking green spaces with the rest of the city infrastructures, securing nature-oriented free spaces, reinforcing street green, supporting urban gardening, private courtyard greening and biological enhancement on business sites, using exclusively native plants and seeds, promoting typical urban species, and considering the strategies’ objectives as basic principles in rule making and planning. A special focus is put on the use of extensive green management measures in parks and elsewhere in order to allow the “uncontrolled” development of a urban wildness “as a contrast to the overregulated world”. This re-wildering as an explicit planning principle, especially but not exclusively, for the many fallow lands (related to the Berlin’s history) is said to provide the city with small nature oases.

This reorientation breaking with the generally seen neat public green has to be conveyed to the community by nature education measures, such as the implementation of pedagogical paths in parks and the integration of environmental teaching into the school curricula from the kindergarden onward.

2/ Appropriation by and participation of urban people. Closely interlinked with these conservation goals is the endeavour to make the urban green experienceable, in order to bring people closer to nature. In the two strategies, green spaces are considered as creative, social and productive spaces that have to be made available for new and environmentally compatible uses. City dwellers are considered as a “part of biological diversity” and their appropriation of urban green is an essential component of Berlin’s free space tradition is claimed to be further expanded. Accordingly, these strategies describe public green spaces should be shaped with the actors of such informal appropriations and bear less the print of city planners than the city dwellers than enliven them.

Examples are given, such as volunteer urban beekeeping and urban gardening, improvised performances in parks, on sidewalks and fallow lands. Parks are conceived as dynamic open-air scenes and experimentation space to encourage the development of a self-made culture.

Finally, these strategies affirm the importance of citizen participation and integration in socially just urban park planning and management, in alignment with general legal regulations of urban planning. They aim to develop and expand flexible cooperation structures, where the different urban stakeholders, from experts and business sector to associations and private citizens take actively part. Appropriation of urban nature is intended to creatively anchor environmental education through a process where “citizens take over responsibility, are reinforced in their engagement, and identify more and more with urban green” (“Strategie Stadtlanschaft Berlin”, translation Z.S.).

III.2. Institutional discourses of public authorities regarding urban parks

Paris

In Paris, ecological practices are promoted in park management, in accordance with the current Biodiversity Plan for Paris and former environmental management norms (ISO 14001) proposed in late 1990'. Based on these norms, quality labels have been created in Paris and at national level (Eco-garden), certifying the ecological maintenance of any given park. All studied parks hold the Parisian label and two of them have also been granted the national label (Buttes Chaumont and Montsouris). Based on these certifications, environmental friendly management measures exclude use of chemical products, promote organic or mineral fertilization only after soil analysis, and promote the acceptance of spontaneous flora with the exception of bindweed and ragweed that are manually removed. Lawns are forbidden to the public during half of the year for regeneration purposes “winter rest” from October 15th to April 15th). Trees are pruned depending on their sanitary state and when necessary for security reasons. Dead trees are replaced or, if possible, the trunk is left at one meter high to favor biodiversity. Organic waste is composted on site, taken off by private compost companies, or crushed and redistributed on the herbaceous stratum. The plant palette is

composed of regional as well as exotic species, based on site's historical criteria. Watering occurs on flower beds, lawns and newly planted trees using tap water. The park's fauna (pollinators, birds, mammals) is monitored by the gardeners on the basis of follow-up sheets and through the participation to the French national specific program of citizen-science "Propage" (dedicated to standardized butterflies monitoring). Fauna management includes the retrieval of goldfish and slider turtles (two exotic species) from ponds, together with rat extermination.

This extensive park management is combined with sensibilization actions, such as environmental education of the park employees, public communication through information at the park entrance, articles in the city council journal, and during the annual Garden day ("Fête des jardins"), and the running of a pedagogical garden in the Parc Montsouris.

Based on the manager discourses, the implementation of naturalistic landscapes in parks aims to shake up visitors' mentalities and to make their representations evolve. However, this objective is perceived as difficult, because of the "culturally unspontaneous relation of city dwellers to nature in Paris" (Paris Park manager). The interviewed park manager stated that the goal is to let people observe nature, to make them "understand", but to maintain people in retreat from some parts of the parks, in order "to favor biodiversity".

Berlin

In Berlin, parks' managers reported similar ecological practices, in accordance with the two city's strategies "Strategie Stadtlandschaft Berlin" and "Berliner Strategie zur Biologischen Vielfalt". From late 1970's (rise of the German Green party in Berlin) and 1980', spontaneous vegetation is left untouched, as vegetation is let growing wherever it intends. Any chemical product is excluded in the parks, while organic fertilizers are allowed. Trees are pruned for sanitary or for security reasons along pathways; trunks are left at a certain height as bird and insect habitat. Pruning is however legally restricted to the September-March period, i.e., outside birds' reproductive season. Horticultural flower beds were said not to correspond to the Berlin park tradition; planted species are mostly

chosen based on their resistance and will in future only be composed of endemic species (transition phase until 2020). In the Görlitzer Park, managers select specific plants that can be touched by people and played with. Lawns are never watered; concerning trees, only young trees are watered, in the 5 years after their plantation, and by using water from nearby canals or from the phreatic table. Organic waste is either composted on site or sold to private compost companies. Monitoring activities concerning park's fauna are led by the city department for Nature Protection, universities and associations. Except for rat extermination near human establishments, there is no control of animal species in the parks.

Different measures of environmental sensibilization are implemented. For instance, the Schäferseepark publicly plants a new tree every year during the Tree Day on April 27th; the Görlitzer Park has fruit bushes in its playground to allow children to come in contact with the vegetation by plucking the fruits. Naturalist associations are allowed to perform pedagogical activities, put nest boxes for birds and beehives and have also a dedicated space in some parks.

The parks are unanimously described by the managers as a social space, where people can organize small public, cultural (lectures, music, theater) or sport events without preliminary authorization, develop new practices and set trends (nudist lawns). In the overall idea, "everyone can do whatever he or she wants" (park manager). Some parks have thus become parks to organise spontaneous parties, as the Görlitzer Park and Treptower Park, while others already host large festivities, as the Technoparade departing from the Grosse Tierpark, and the fair "Neuköllner Maientage" of several days' duration at Volkspark Hasenheide. If limitations are set up, such as to keep dogs on the leash, the barbecue ban in the parks since a few years, or ball games in some park areas, these are often balanced through the implementation of a dedicated space for these activities or dog parks within the park.

More generally the parks integrate activities and structures from the public realm, such as kindergartens, senior citizen associations, a hospital, open air cinema, a Hindu Temple (currently under construction).

Contrary to in Paris, city dwellers are officially strongly invited to get involve in parks-related decision-making processes. For instance, the Görlitzer Park has been planned in the 1990' in collaboration with the people from the neighbourhood; in the Treptower Park and Volkspark Hasenheide, children have contributed during workshops to the design of their future playgrounds. The Görlitzer Park set up an “innovative management strategy” where city dwellers participated in the elaboration of the current management plan. During this process, discussion tables were installed in the middle of the park to allow a increased number of people to informally join the discussions. Several parks also rely on the inhabitants for the care of the park, as in the co-managed Lietzenseepark, or as in the Schäfersee Park and the Görlitzer Park, where people are in charge with watering fruit trees or flower beds and with picking up the autumn leaf. According to the park managers, the ultimate goal of involving the city dwellers in the park planning and management and allowing them to take liberties in using the park is to bring the space in accordance with social expectations, thus reaching a value-creation of and identification with the park. In return, people are expected to take responsibility for their green space as a common property. Negative effects of this strategy have however been pointed out such as littering, which was mentioned by all park managers, and problems of overt drug traffic in the Görlitzer Park and Volkspark Hasenheide (as could easily be observed by ZS during data collection on the parks' landscape features).

III.3. Urban park features in Paris and Berlin

The parks in Paris and Berlin did not significantly differ in the majority of the assessed features: number of trimmed hedges ($P= 0.25$), flowerbeds ($P= 0.52$), lawns ($P= 0.33$), forbidden lawns ($P= 0.57$), statues and fountains ($P= 0.01$), presence of grass on the pathways ($P= 0.64$), sports and playgrounds ($P= 0.92$), dog parks ($P= 0.99$).

However, we found significant differences between Paris and Berlin, concerning four landscape features: more meadows in Berlin than in Paris ($P= 0.0005$), more natural ponds in Berlin than in Paris ($P= 0.0038$). On the contrary, we found more benches and chairs in Paris than in Berlin ($P= 2 \times 10^{-5}$).

16); the same for artificial ponds ($P= 0.0028$). Additionally, we found a significantly higher number of bans at the park entry in Paris ($P= 0.0009$), as well as the presence of gards in Paris only ($P= 0.0037$). Fencing with closing hours was further encountered in Parisian parks only ($P= 0.002e-02$).

III.4. Representations of urban biodiversity for participants in neighborhood councils in Paris and Berlin

The respondents of Paris and Berlin did not differ significantly in their answers concerning the Objectification vision of nature (vision 2, Nature as commodity and ornament $P= 0.205$), nor concerning the Stewardship vision (vision3, Nature to be safeguarded, $P= 0.25$), nor Oneness vision (4, Up close nature, $P=0.28$). For all these three visions of nature, the level of acceptance of these visions did not significantly depend either from individual practices such as the contact with nature, civic engagement nor the use of sanitary products.

In contrast, respondents in Paris had a significantly higher response rate concerning the Mastery of Nature vision than in Berlin (vision 1, Nature to be contained $P= 0.013$).

IV. DISCUSSION

In this study, we collected data from different angles to understand the consistency of three hierarchical levels in urban green management in Paris and Berlin (general strategies, discourse of urban park managers, bio-physical reality), as well as with urban citizen's representations of nature. Our results are consistent with each other in each city, and contribute to propose two distinct formal models, that we discuss in the following.

Both Berlin and Paris have very similar ecological and social objectives, which are favoring urban biodiversity in parks and within the whole city through extensive management, as well as raising public awareness on environmental issues. Both city strategies insist on the necessity to stimulate a

positive perception and acceptance of urban animal and plant species by city dwellers. The tools used to influence these representations however differ substantially. Indeed, Paris invests in knowledge transmission to promote nature preservation and tries to call attention to forms of ecological measures that may be interpreted as a lack of care. In opposition to this top-down approach, Berlin bets on a bottom up strategy giving city dwellers opportunities to engage with nature through participation in decision-making and green space appropriation. More precisely, environmental education in Paris remains cognitive and mediated by intellectual understanding of urban nature; in contrast, in Berlin, environmental education is anchored in individual pro-active experience of and identification with nature.

This difference in official strategies results in two contrasting planning and management strategies of urban parks. Indeed, enhancing biodiversity in Paris goes along with keeping people in retreat, by prohibiting access to the lawns half of the year and to fallow lands, while encouraging people to sit apart (significant higher number of chairs and benches), fencing green spaces, restricting human activities in the parks (significant higher number of bans at park entries), and ensuring a control function (gard presence). In contrast, green and social space are perceived as a single entity in Berlin. This vision relies on the historical concept of “Volkspark” (see above), and considers the green space as a common property to be cooperatively designed and taken care of but also enliven and placed at the social disposal. This is shown by the high level of public engagement in park design and management, as well as the numerous individual liberties in green space uses and the integration of activities and structures in the parks that are not dedicated to nature. In addition, Berlin’s parks showed a more naturally-designed landscape than Paris’ parks, with a significant higher number of natural ponds and meadows. This unmanaged-like landscape within the parks may contribute to bring people to positively associate a nature that is not highly managed with the generally pleasant park experience.

The two management practices of urban green spaces in Paris and Berlin could therefore be summarized as two visions of nature conservation: inclusive in Berlin and exclusive in Paris.

These two contrasting views could have been explained by the former existence of two contrasting visions of urban citizens regarding their relations to nature, Parisian people being less close and connected to nature (as suggested indeed by one interviewed manager) than Berliner people. However, we did not find such difference in our survey. In contrast, we found no difference in the levels of ecocentric views of nature, i.e. oneness to nature (relation 4) and stewardship (relation 3). More, we did not find any significant difference either in the level of esthetical vision of nature (i.e., objectivication, relation 2). In contrast, we found a significant difference in the control relation to nature, Parisian respondents having a significantly stronger control relation (Nature to be contained, relation 1) than those in Berlin.

The only difference in the perception of urban nature between the people we asked in Berlin and Paris is on control relation, which is closely related to the exclusive perception of nature management by local authorities in Paris. We can therefore hypothesize that public strategies in Paris controlling people's access to nature in urban green spaces, may contribute to cultivate this view. However, this exclusive vision is not dedicated only to nature management, but also to environmental education, with local authorities willing to learn people to observe but not to disturb urban nature. In addition, ecological conservation measures are implemented without actively involving city dwellers. Yet, different studies underlined that communication strategies based only on information hardly result in changes in environmental individual behaviour, contrary to commitment strategies (e.g., Steg and Vlek 2009) and direct personal experiences of nature that favor affective interests to natural landscapes (e.g., Miller 2005). Therefore, when keeping people separated from urban biodiversity and when keeping a strict control of nature within the urban parks, the dualistic paradigm of the human-nature divide, that underlies precisely the control vision of nature, remains unshaken. As a consequence, we predict that this view of nature is likely to undermine the acceptance of novel biodiversity-friendly practices implemented in Paris public places (e.g., reduction of phytosanitary products and acceptance of spontaneous vegetation growing in the streets) which will stay considered as a lack of control by Parisian people.

We acknowledge that Berlin has substantially more green spaces than Paris that could act on people's qualitative perceptions of and relation to nature. However, would this factor be crucial, we would also and even more expect divergence in respondents' answers on the ecocentric views "Nature to be safeguarded" (Stewardship) and "Up close nature" (Oneness with nature), which was not the case in this study. On the contrary, we do not exclude the possibility that the higher amount of fallow lands in Berlin, due to the city's history, has habituated people to naturally kept or "unmastered" areas within the city, leading to a lower control vision of nature in Berlin than in Paris.

Finally, we want to embed our results in a more general vision of integrated environmental and social issues, referring to Sen's framework of "capabilities" for individuals of achieving the kind of lives they have reason to value (Sen 1985). Without denying the possibilities of general regulation nor the existence of social norm, this framework emphasizes the objective of expanding individual freedoms that people value (Alkire 2008). In this framework, local authorities and collectives are encouraged to provide the largest possible "capability set", i.e., the range of real possibilities for individuals to achieve outcomes that they value (i.e. "valuable functionings", Alkire 2005), that they can further choose freely and open diverse paths for their future (Alkire 2005).

Based on this framework and consistently with our results, we argue that local authorities' social objectives of reconnecting people with nature should better provide opportunities for city dwellers to experiment by themselves nature and biodiversity in public spaces in the city. This is also consistent with various results coming from environmental education, that stated that environmental education does not take place through one single environmental discourse, but rather through a plurality of complementary and competing discourses (Gustafsson 2013). Contextual features such as landscape planning provide implicit discourses on environment and urban nature that should better not compete with explicit messages of official environmental discourses. On the contrary, leading to a larger set of possible individual uses and practices in urban green spaces could let people experiencing their freedom in both nature and social relationships, and eventually contribute to bringing ecological goals and social perceptions into better alignment.

ACKNOWLEDGEMENTS

We would like to thank Assaf Shwartz, Romain Julliard, and all those who enabled through their participation this study: the city councils in Paris, Conseil de quartier Montsouris-Dareau, Conseil de quartier Pernety, and in Berlin, Quartiersrat Letteplatz, Quartiersrat Magdeburger Platz, Quartiersrat Ganghofer Kiez, Quartiersrat Schillerpromenade, Quartiersrat Wrangelkiez, as well as the urban park departments in Berlin, Fachbereich Grünflächen Bezirksamt Neukoelln; Fachbereich Grünflächen Bezirksamt Friedrichshain-Kreuzberg; Fachbereich Grünflächen Bezirksamt Charlottenburg-Wilmersdorf; Abteilung Stadtentwicklung, Umwelt, Ordnung und Gewerbe Bezirksamt Reinickendorf; Tiefbau- und Landschaftsplanungsamt Bezirksamt Mitte; Tiefbau- und Landschaftsplanungsamt Treptow-Köpenick; and in Paris, Direction des Espaces Verts et de l'Environnement.

REFERENCES

- Alkire S. 2008. Choosing dimensions: The capability approach and multidimensional poverty. In Kakwani N. and Silber J. (ed.) *The Many Dimensions of Poverty*. New-York: Palgrave Macmillan, pp. 89-119.
- Alkire S. 2005. Why a Capability approach? *Journal of Human Development* 6: 115-133.
- Balram S., Dragičević S. 2005. Attitudes toward urban green spaces: integrating questionnaire survey and collaborative GIS techniques to improve attitude measurements. *Landscape and Urban Planning* 71: 147–162.
- Blaikie P. 1999. A Review of Political Ecology. Issues, Epistemology and Analytical Narratives. *Zeitschrift für Wirtschaftsgeographie* 43(3-4): 131-147.
- Chiesura A. 2004. The role of urban parks for the sustainable City. *Landscape and Urban Planning* 68: 129–138.
- Choay F. 2000. *HAUSSMANN Georges-Eugène (Baron), Mémoires*. Paris : Editions Le Seuil.
- Direction Générale de l'Aménagement, du logement et de la nature. 2012. *Trame verte et bleue Expériences des villes étrangères*. Berlin, métropole naturelle.

Colding J. 2007. Ecological Land-use Complementarity for building resilience in urban ecosystems. *Landscape and Urban Planning* 81: 46-55.

de Groot W.T. and van den Born R.J.G. 2003. Visions of nature and landscape type preferences: an exploration in The Netherlands. *Landscape and Urban Planning* 63: 127–138.

Gandy M. 2006. Urban Nature and the Ecological Imaginary. In N. Heynen, M. Kaika and E. Swyngedouw (Eds.), *In the Nature of Cities Urban political ecology and the politics of urban metabolism*. London & New York : Routledge. 62-72.

Gobster P.H., Nassauer J.I., Daniel T.C., Fry G. 2007. The shared landscape: what does aesthetics have to do with ecology? *Landscape Ecol* **22**:959–972.

Gobster P.H. 2001. Visions of nature : conflict and compatibility in urban park restoration. *Landscape and Urban Planning* 65 :35-51.

Grimm N.B., Faeth S.H., Golubiewski N.E., Redman C.L., Wu J., Bai X., Briggs J.M. 2008. Global Change and the Ecology of Cities. *Science* 319: 756-760.

Grimm N. B., Grove J.M., Pickett S.T.A., Redman C.L. 2000. Integrated approaches to long-term studies of urban ecological systems. *BioScience* 50:571-584.

Gustafsson K.M. 2013. Environmental discourses and biodiversity: the construction of a storyline in understanding and managing an environmental issue. *Journal of Integrative Environmental Sciences* 10(1):39-54.

Heynen N., Kaika M., Swyngedouw E. 2006. Urban Political Ecology. Politicising the Production of Urban Natures. In N. Heynen, M. Kaika and E. Swyngedouw (Eds.), *In the Nature of Cities Urban political ecology and the politics of urban metabolism*. London & New York : Routledge. 1-19.

Hostetler M., Allen W., Meurk C. 2011. Conserving urban biodiversity? Creating green infrastructure is only the first step. *Landscape and Urban Planning* 100: 369–371.

Jorgensen A., Hitchmough J., Calvert T. 2002. Woodland spaces and edges: their impact on perception of safety and preference. *Landscape and Urban Planning* 60:135–150.

Mairie de Paris. 2011 Plan Biodiversité de Paris. Programme d'Actions pour Préserver et Enrichir la Biodiversité à Paris.

Mension-Rigau E. 2000. Les jardins témoins de leur temps. *Historia* 7-8.

Menozi M-J. 2007. « "Mauvaises herbes", qualité de l'eau et entretien des espaces ». *Natures Sciences Sociétés* 15 : 144-153.

Miller J.R. 2005. Biodiversity conservation and the extinction of experience. *Trends in Ecology and Evolution* 20: 430-434.

Novarina G. 2003. Ville diffuse et système du vert, *Revue de géographie alpine*. 91(4): 9-17.

Özgüner H. and Kendle A.D. 2006. Public Attitudes Towards Naturalistic Versus Designed Landscapes in the City of Sheffield (UK). *Landscape and Urban Planning* 74 : 139–157.

Senatsverwaltung für Stadtentwicklung und Umwelt Berlin (a). 2012. Berlins Biologische Vielfalt. Berliner Strategie zur Biologischen Vielfalt.

Senatsverwaltung für Stadtentwicklung und Umwelt Berlin (b). 2012. Strategie Stadtlandschaft Berlin natürlich urban produktiv.

Schipperijn J., Stigsdotter U.K., Randrup T.B., Troelsen J. 2010. Influences on the use of urban green space—A case study in Odense, Denmark. *Urban Forestry & Urban Greening* 9: 25–32.

Sen A. 1985. *Commodities and capabilities*. Oxford: Elsevier.

Shwartz A., Turbé A., Simon L., Julliard R. 2014. Enhancing urban biodiversity and its influence on city-dwellers: An experiment. *Biological Conservation* 171: 82–90.

Smith N. 2006. Foreword. In N. Heynen, M. Kaika and E. Swyngedouw (Eds.), *In the Nature of Cities Urban political ecology and the politics of urban metabolism*. London & New York : Routledge

Standish R.J., Hobbs R.J. Miller J.R. 2013. Improving city life: options for ecological restoration in urban landscapes and how these might influence interactions between people and nature. *Landscape Ecology* 28:1213–1221.

Steg L. and Vlek C. 2009. Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology* 29: 309–317.

CHAPTER 4

Modeling an Urban Social Ecological System : Towards Coexistence Between People and Pigeons in the City

CHAPTER INTRODUCTION

In conclusion, I used a concrete case study to examine how new governance models could mediate social conflicts about urban biodiversity by considering the underlying nature perceptions and social-ecological processes. I aimed to highlight to what extent different human and non-human stakeholders, as well as parallel discourses resulting from their interactions, shape the social meaning of biodiversity (or of specific species) and affect human attitude.

As a general conclusion of my PhD thesis, I propose a new analysis of the social conflict concerning the presence of urban pigeons in contemporary French cities and a mitigation approach that both depart from classical models, which only focus on the distribution and abundance of pigeon populations. My colleagues and I offer a novel vision of the relations between urban citizens, local authorities and urban pigeons that combines ecological and sociological data to build a model of integrated governance of pigeons in cities. In this model, we treated human-pigeon coexistence not solely in terms of pigeon population control, but more generally in terms of resilience by reducing the public dissatisfaction regarding pigeons. To do this, we considered social perceptions of pigeons as central to the model. We also considered the set of interrelations between humans and pigeons by including an increased number of stakeholders and stressing the reciprocal linkages between them.

As a result, we highlight the importance of a holistic vision in the implementation of political measures and governance models of urban nature.

MANUSCRIPT

**Modeling an Urban Social Ecological System: Towards Coexistence Between
People and Pigeons in the City**

Zina Skandrani^{1*}, Marion Desquilbet², Anne-Caroline Prévot¹

Environmental Science and Policy (Submitted)

¹ Centre d'Ecologie et des Sciences de la Conservation CESCO, UMR 7204 CNRS-MNHN-UPMC, Museum National d'Histoire Naturelle, CP 51, 55 rue Buffon, F-75005, skandrani@mnhn.fr, acpj@mnhn.fr, +33 1 40 79 37 18

² Toulouse School of Economics (GREMAQ, INRA), 21 allée de Brienne, 31015 Toulouse cedex 6, France, marion.desquilbet@toulouse.inra.fr, +33 5 61 12 85 78

KEYWORDS: Biodiversity governance; Pigeons; Socio-ecological systems; Public policies; Institutional communication.

I. INTRODUCTION

In addition to ecological issues, the loss of the sense of interrelations is advanced by some authors as a main dimension of the current biodiversity crisis, be it interdependence with nature and biodiversity or interrelations with other humans (Koger and Winter 2010). And indeed, ever-increasing urbanization and the modern western way of life (Mc Kinney 2002, Rosenzweig 2003) clearly discourage direct contact with nature and biodiversity (Miller 2005, Louv 2008), as well as between humans (Moser 1994). Yet while urban biodiversity is much less abundant and diverse than in more natural habitats (Mc Kinney 2002), some animal species have adapted particularly well to the proximity of humans by exploiting their resources (Mc Kinney 2002, Clergeau 2007, Moller 2008). However, rather than helping to connect humans with nature, the presence of these species is sometimes a source of conflicts with urban citizens, such as for instance with rabbits, foxes, seagulls, rats, coyotes, deer, cougars, geese etc. (Kalof and Amthor 2010), potentially leading to social conflicts as well (Fall and Jackson 2002, Gouabault and Burton-Jeangros 2010); there is no integration of biodiversity presence and dynamics in these anthropogenic ecosystems (see reconciliation ecology, Rosenzweig 2003). Among biodiversity issues, a major challenge lies therefore in finding a way of coexistence between humans and wild fauna in cities. Moreover, the presence of biodiversity in cities could be the opportunity for humans to rethink and rebuild their interrelations with nature and with other humans.

In anthropogenic environments, many authors have recently underlined the importance of considering ecological and social systems together, as socio-ecological ecosystems, rather than independently (Pickett et al. 2008, Mugerauer 2000, McDonnell and Pickett 1990). The analysis of these authors is original for its study of the reciprocal influence and dynamics among social, political/institutional and ecological variables (Ostrom 2009). By explicitly including human perceptions and actions, as well as institutional planning and management, these frameworks are much more powerful for understanding the dynamics of ecological systems in urban environments than those with only ecological variables (Grimm et al. 2000).

One famous example of this difficult cohabitation concerns the presence of feral pigeons, *Columba livia*, in cities. Feral urban pigeons, the descendants of domesticated rock doves that were bred all around the world, are currently present in most large cities throughout the world, after their abundance increased in the first part of the 20th century (del Hoyo et al. 2005, Johnston and Janiga 1995).

Urban pigeons are commonly depicted as “pests” and have led to continuous institutional efforts to control their abundance (Haag-Wackernagel 2002). Urban pigeons are mostly ascribed with a highly negative image in the mainstream public opinion (Vuorisalo et al. 2001) and are typically objects of complaints in most major occidental cities since the mid-20th century. The most frequent complaints relate to viruses and diseases of pigeons, because of which pigeons are viewed as a threat to humans, “rats with wings” (Jerolmack 2008). Throughout history, however, pigeons have taken on important symbolic and functional roles, so that the dislike for pigeons is relatively new compared to their history of co-existence with humans (Skandrani et al. 2014). As a consequence of their central significance to humans for thousands of years, pigeons have retained a portion of their status as a peace symbol (e.g., the logo of the United Nations, Picasso’s famous painting for the 1949 World Peace Congress, pigeon releases by the Pope or in weddings, etc.) and still have active supporters among urban dwellers (Colon and Lequarré 2013, Jerolmack 2007). Urban pigeons are thus among the few species that may cause social conflicts (Jerolmack 2008), given that individuals have very strong stances for or against them (Colon and Lequarré 2013, Skandrani et al. 2014).

Here, we provide an example of how processes from the ecological environment, the social realm and public policies can be integrated in a multi-scale formal framework. Combining social and ecological approaches, we consider the challenge of human-pigeon coexistence not solely in the terms of pigeon population control, but more generally in terms of the resilience of the whole socio-ecological system by increasing the social acceptability of pigeon presence. In this, our model meets the view of Fall and Jackson (2002) who advocate that “toleration”, which is still the most widely used strategy for wildlife conflict problems, should most likely be the strategy of choice more often

than it is. This model of integrative governance therefore defines as an objective the increase in the social well being of citizens, through the reduction of public dissatisfaction regarding pigeons.

To do this, we consider the set of interrelations between humans and pigeons in French cities, by including an increased number of stakeholders and factors of interest compared with traditional pigeon management models and by stressing the reciprocal linkages between them in a model of urban biodiversity governance: city dwellers (and their well-being), local public authorities (and their willingness to decrease complaints and increase electors' satisfaction) and urban pigeons (and their ecology).

We believe that by reframing the goal of public actions, this model will give some practical advice on possible ways to address the "pigeon problem" in its entirety. More generally, we aim to illustrate how understanding interactions and feedbacks between humans and non-humans improves our view of socio-ecological systems, which can be used to find viable solutions for increasing individual and collective well-being. The use of these insights could be encouraged in general public policy and land management.

II. CURRENT COMMON METHODS TO CONTROL PIGEON ABUNDANCE ARE NOT EFFECTIVE

Urban pigeon populations have been controlled in many different metropolises, such as New York (United States), London (United Kingdom), Basel (Switzerland), Barcelona (Spain) and Paris (France), using different methods (see Haag-Wackernagel 2002 for a review). The reduction in abundance is based on reducing adult survival and/or reducing reproductive success, by sterilizing adult females or removing the eggs. In addition, indirect measures include the attempt to lower ecological resources, i.e., food and/or breeding sites.

II.1. Increasing adult mortality by culling methods

Massive adult culls by shooting or poisoning have been widely used as a population control method in the past (Sol and Senar 1992), without any factual decrease in population sizes (Giunchi et al. 2012). Urban pigeons are a long-lived species, with the annual adult survival rate estimated at up to 0.824-0.886 (Recapet et al. 2013). In such a long-lived species, the population growth rate is very sensitive to changes in adult survival (Caswell 1989). However, because of the high flexibility of pigeon populations in terms of reproduction and dispersal, culled birds are soon replaced by new juveniles and immigrating birds from other areas (Magnino et al. 2007). Moreover, because of its unethical nature, this method fails to attain public acceptance (Fall and Jackson 2002). Thus, while it might still be employed by some municipalities (Senar et al. 2009), it has been largely abandoned in Central Europe (Haag-Wackernagel 1995).

II.2. Inhibition of reproduction

Urban pigeons can breed several times a year and reproduce throughout the year (Johnston and Janiga 1995), but there is still seasonality in reproduction (Jacquin et al. 2010). They typically lay two eggs every two to three months (Johnston and Janiga 1995), and the juvenile survival rate remains very low (approximately 0.5 per month after fledging, Recapet 2013). Lowering reproductive success has been attempted through sterilizing adult females or removing laid eggs. However, demographic modeling shows that in long-lived species, these measures do not impact the population growth rate significantly, due to the high number of breeding opportunities for adults (Caswell 1989). Moreover, lowering the number of young pigeons in a particular site encourages the immigration of new individuals (Jacob et al. in revision) and/or the reproduction of other adults, unless the ecological conditions are changed (see next section).

Indeed, the implementation of public urban dovecotes built in western cities to sterilize or replace most laid eggs (Jacquin et al. 2010, Johnston and Janiga, 1995) has proved to be ineffective in limiting urban pigeon populations (Giunchi et al. 2012). Similarly, control measures based on chemosterilants

or other adult reproductive inhibitors have also showed relatively low success (e.g., Baldaccini 1999). Moreover, the dispersion of chemosterilants in the human environment can be questionable (Haag-Wackernagel 1995) because of their potential ingestion by non-target animals such as pets, as well as children.

II.3. Limiting resources

II.3.1. Feeding ban

Together with feral cats or domestic sparrows, urban pigeons are regularly fed by some people, for different personal or cultural reasons (e.g., Colon and Lequarré 2013). These regular feeding practices are often identified as a major factor for pigeon population growth (e.g., Haag-Wackernagel 2005, 1997). Several Western cities have implemented a feeding ban on pigeons and urban birds in general in the last decades, potentially resulting in high fines (over 400 euros in France; Colon and Lequarré 2013). However, except for a study from 1988 for the city of Basel (Haag-Wackernagel 1995), to date there are no published data arguing that feeding bans has any impact on pigeon numbers (Buijs and van Wijnen 2001). For instance, the relative importance of food from regular feeding practices compared to the total food available to pigeons in cities remains unknown. Moreover, in an analogous history of city colonization by the hooded crows *Corvus corone* in Finland, Vuorisalo et al. (2003) argue that the importance of food availability for crows' population growth was most likely overestimated in previous research; indeed, crow population growth occurred simultaneously with a decrease in urban food resources due to the improvement of sanitary conditions and the incineration of food waste. Regarding pigeons, they can fly long distances and can forage in farmland around cities (Rose et al. 2006). This strategy can strongly influence the population size in towns (Hetmanski et al. 2011), with different effects in different cities: the proportion of the pigeon population relying on food from outside of the cities can be quite low (e.g., 6% in Basel: Switzerland, Rose et al. 2006), or on the contrary very high (e.g., 46% in Milan: Sacchi et al. 2002). Soldatini et al. (2006) further report variability in pigeons' foraging techniques inside or

outside the city throughout the year, depending on the distribution and availability of food resources. This suggests that a feeding ban does not guarantee any limitation in pigeon numbers, as they can flexibly switch to other foraging sources.

II.3.2. City planning and architecture

Wild rock doves have historically bred on cliffs in colonies (Baldaccini et al. 2000). Due to this evolutionary origin, urban pigeons look for vertical and rough surfaces for breeding. The architecture of some old buildings thus provides an important supply of nesting opportunities (Sacchi et al. 2002, Ragni et al. 1996). These nesting sites constitute an ecological resource that can be artificially regulated, for instance through the obstruction of nesting-suitable slits in buildings. This strategy has indeed proved to be highly effective in Perugia (Italy), for instance, with a reduction of 23% of the city's pigeon population in one year (Ragni et al. 1996). However, except for train stations, airports, historical buildings, and midtown areas, this strategy is not systematically carried out in large cities (Giunch et al. 2012). Moreover, this measure may also come up against existing legal prescriptions on the built environment, as in the case of legal restrictions in historic monuments (in France, law on the protection of historic monuments, 31 Dec. 1913, Art L. 621-1 du Code du Patrimoine).

II.4. Reducing pigeon numbers is practically impossible on realistic political implementation scales

Several different public policy approaches have thus already been tried to reduce the number of pigeons. However, despite high costs (Zucconi et al. 2003, Pimentel et al. 2000, Haag-Wackernagel 1995, Bevan 1990), these control measures have never succeeded in decreasing the size of pigeon populations (Johnston and Janiga 1995).

In addition to the causes described above, the geographical scale at which these methods are implemented explains their low success. Indeed, a recent genetic study (Jacob et al. in revision) confirmed that urban pigeons can disperse within a larger geographical area than a single policy unit (e.g., Paris city). To be efficient, regulation measures must therefore be implemented together by all

the neighboring cities in the whole urbanized area. Yet, so far, public measures on pigeon regulation have always been decided and implemented independently at the city scale, i.e., always at a smaller scale than the actual pigeon dispersal and colonization range.

Based on these considerations, and because we want to discuss feasible management solutions, we consider in our analysis that controlling the number of pigeons is not possible. Instead, we consider another variable of interest, “pigeon aggregation”. Indeed, when in high densities, urban pigeons often concentrate in flocks, and this aggregation is one of the main causes of social discomfort relating to pigeons (Jerolmack 2008). When controlling the number of pigeons is out of reach, controlling their local aggregation may be an alternative way to lower apprehensions towards them.

III. MODELING MANAGEMENT STRATEGIES OF URBAN PIGEONS BASED ON SOCIAL PERCEPTIONS

The socio-ecological model presented here was built based on insights gained through a multi-year research-action program on urban pigeons run by the French National Museum of Natural History (MNHN) and other scientific and non-scientific partners (subsequently referred to as the “MNHN pigeon program”).

The objective function of our model is to increase the social well being of citizens cohabiting with urban pigeons, through the decrease of social dissatisfaction regarding pigeons. Indeed, social acceptance of pigeons and lower apprehension towards them may allow a reduction of social discomfort (Serpell 2004) with pigeon presence in the city, as well as appeased socio-ecological relations. Therefore, in this model, we defined the “social perception” of pigeons as the objective function of the model. We further defined two biological variables that may interfere with the objective of improving the social perception (P) of the pigeon issue: the aggregation (A) and the health (H) of pigeons. In addition, we considered five types of public policies that may affect the level of social perception and/or the level of the two biological variables A and H. Three of these public policies are specific to pigeons: public dovecotes (PD), a feeding ban (FB) and public communication

towards pigeons (PC). The two others are more general: city planning (CP) and public cleanliness (CI). As detailed in the following sections, interactions among public policies in cities, the biology of pigeons and social perceptions towards pigeons can be meaningfully synthesized in the following formal model (schematized in Figure 1).

The health of pigeon populations in cities depends on three public policies: the establishment of public dovecotes, sidewalk cleanliness measures and whether a feeding ban is implemented or not:

$$(1) H = f_H(PD, CI, FB)$$

The aggregation of pigeon populations in cities depends on these three public policies, as well as on city planning measures:

$$(2) A = f_A(PD, CI, FB, CP)$$

The social perception of pigeons depends directly on the aggregation and health of pigeons, which make them depend indirectly on the four aforementioned public policies. In addition, they also depend directly on the three public policies that are specific to pigeons, that is, public dovecotes, the presence or absence of a feeding ban, and public communication towards pigeons:

$$(3) P = f_P(A, H, PD, FB, PC)$$

As developed in the following sections, we propose that the implementation of more public dovecotes and increased measures of public cleanliness both decrease the aggregation and increase the health of pigeons, while a feeding ban has the opposite consequences. In addition, possible city planning measures could decrease the aggregation of pigeons. A lower aggregation and better health of pigeons positively affect the social perception of pigeons. In addition to these biological variables, social perception is positively affected by the establishment of public dovecotes, while they are negatively affected by the implementation of feeding bans. Finally, depending on its scope and implementation, public communication towards pigeons may either enhance or reduce social perception towards pigeons.

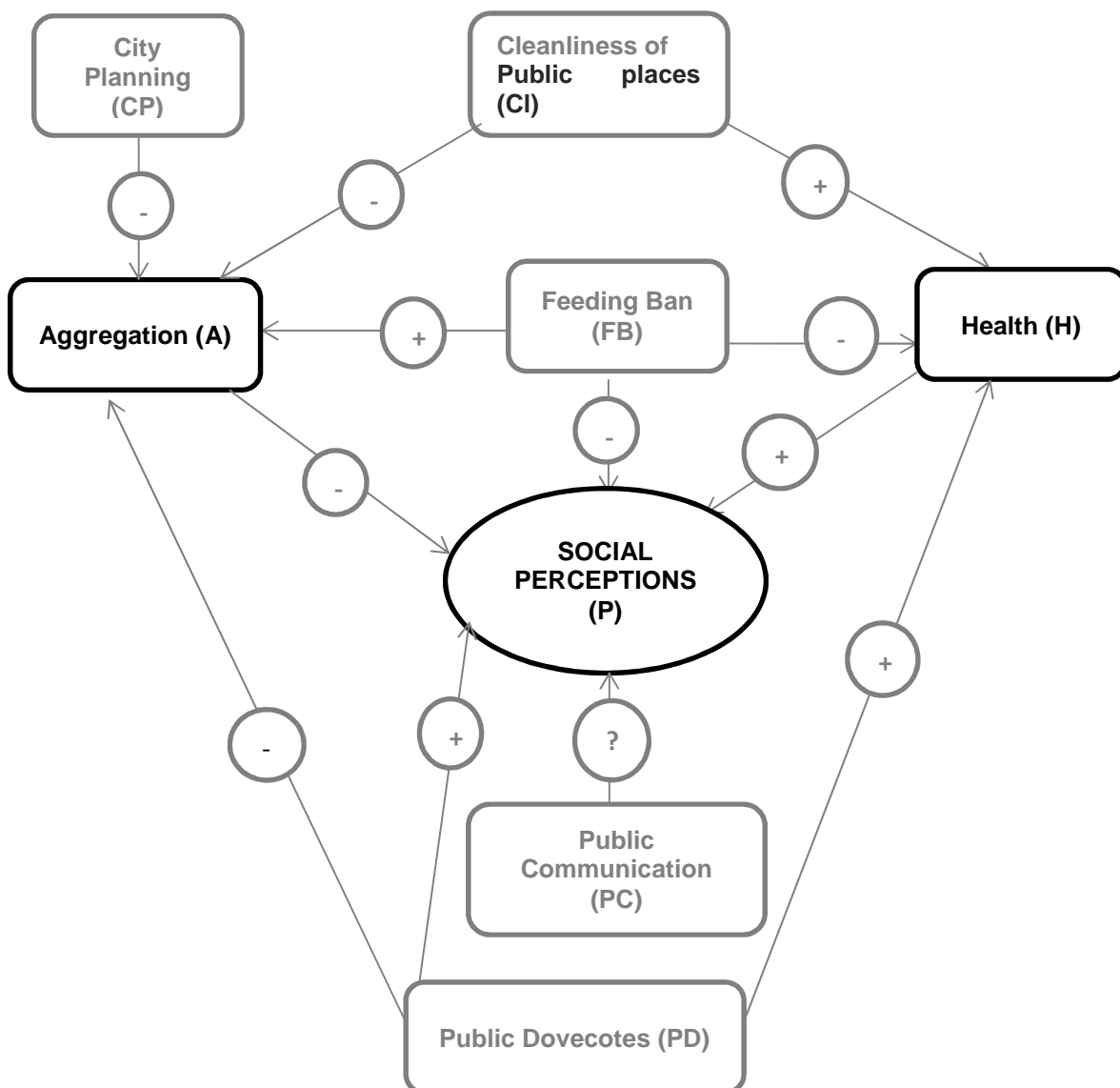


Figure 1. Model for urban pigeon governance

Note: The signs + and – in relations indicate positive or negative relationships. Public policies are in grey; biological variables and the objective function are in black.

III.1. Aggregation of urban pigeons

Historically in France, the first complaints related to feral pigeons appeared when pigeons became abundant and visible in cities, in the period between the two World Wars (Givois 2009). The growth of urban pigeon populations was favored and triggered by various favorable factors: a large amount of food on city streets and in marketplaces, numerous nesting sites in buildings, increased farming productivity with surpluses of grain (Johnston and Janiga 1995), and the high annual reproduction rate of pigeons that had been selected for during their former domestication. Like their ancestors the wild rock doves, urban pigeons behave as a social species (Baldaccini et al. 2000), as evidenced by their foraging behavior (Soldatini et al. 2006; Lefebvre and Giraldeau 1984). Contrary to granivorous rock doves (del Hoyo et al. 2005), feral pigeons are much more opportunistic and omnivorous in cities, where they typically forage on the ground with a very wide feeding range (from seeds to refuse). When the quantity and location of food are unpredictable, urban pigeon flocks tend to be bigger (Lefebvre and Giraldeau 1984).

In cities, urban pigeons are mainly present on the ground, and do not hesitate to roam beyond urban parks and use sidewalks. Their flight distance (i.e., the distance at which the birds take flight when a human approaches) is quite small compared to those in other bird species (approximately 1.8 m on average; MNHN pigeon program); they therefore live close to pedestrians.

Several public policies are correlated with pigeons' aggregations, as detailed below.

III.1.1 Cleanliness of public places

Pigeon numbers in a local area (i.e., aggregation) has been found to be correlated with the local quantity of organic waste produced in the city (Buijs and Van Wijnen 2001). Indeed, urban pigeons feed on organic waste (Jokimäki and Suhonen 1998) and concentrate in places where food is readily available (MNHN pigeon program). When ground spaces (sidewalks, streets, parks etc.) are not cleaned, the availability of organic waste is higher, providing feeding resources for urban pigeons.

Cleanliness of public places in a city may thus be negatively correlated with local concentrations of pigeons.

III.1.2 Feeding ban

This public policy may have some unintended consequences by favoring gatherings of pigeons. Indeed, besides the ban, many people continue to feed pigeons, but they are constrained to act fast and secretly. As a result, they feed pigeons early in the morning or late in the evening, and deposit large amounts of seeds at once, instead of small quantities in many places (Colon and Lequarré 2013). By doing this, they can encourage aggregations of pigeons.

III.1.3. Public dovecotes

Public dovecotes could be a way to displace pigeon gatherings away from people's living areas or highly frequented spots. Indeed, a study by Dehay (2008) highlighted a very low dispersion of pigeons around dovecotes to which they are faithful in Paris (a few hundred meters), and pigeons have been found to be more highly philopatric towards their breeding sites (Hetmansky 2007).

III.1.4. City planning and architecture

Pigeons typically breed in social groups on vertical surfaces, which are reminiscent of the natural cliffs where their wild ancestors used to breed (Johnston and Janiga 1995). Depending on architectural designs, built infrastructures therefore offer good opportunities for pigeons to land and concentrate. Different deterring systems already exist to discourage pigeons to land (Haag-Wackernagel 2000); these methods are efficient at a very local scale, to protect one given infrastructure. However, in this circumstance, pigeons move only the least distance possible from the protected structure.

III.2. Health of urban pigeons

Urban pigeons host numerous parasites, including Chlamydia, which can be transmitted to humans. However, repeated scientific studies have asserted the low potential health hazards of pigeons and their transmission risk to humans (Gasparini 2011, Haag-Wackernagel and Moch 2004). In addition, pigeons do not carry diseases that are not also carried by other urban birds (Jerolmack 2007).

Pigeons' health depends on different variables, both environmental and intrinsic: the quantity of pollutants present in pigeons' feathers may depend on the local pollution of the environment (Frantz et al. 2013, Nam et al. 2004); the prevalence of haemosporidian parasites (*Haemoproteus* spp. and *Plasmodium* spp.) in pigeons depends on both the pigeon morphs and the urbanization rate (Jacquin et al. 2013); and large pigeon gatherings impact pigeon health (Haag-Wackernagel 2002, Pimentel et al. 2000). The visible sanitary state of pigeons could be decisive in determining people's emotional apprehensions, as Stokes (2007) already showed the impact of aesthetic features on people's preferences and affective responses to biodiversity. Several public policies may impact pigeon health, as described below.

III.2.1. Public dovecotes

Public dovecotes may impact the sanitary state of pigeons by providing them with more hygienic nesting sites and better or more adequate food (Magnino et al. 2008). In addition, the presence of food inside the dovecotes may limit pigeon foraging on the ground and lower their risk of injury. This is not necessarily the case, however: a study by Gasparini et al. (2011) found that the excretion level of Chlamydiaceae did not significantly differ between pigeons captured in a dovecote and pigeons captured on the street.

III.2.2. Cleanliness of public places

In some large cities such as Paris (France), a variable proportion of pigeons show foot mutilations. A preliminary study showed that the levels of foot mutilations of individual pigeons (atrophied claws,

stumps) are correlated with the density of inhabitants in the neighborhood (Sunnen, Jiguet and Prévot, unpublished). This result is reinforced by direct observations of pigeons injured by hairs or strings wrapped around the feet when ringing pigeons during the MNHN pigeon program. These results and observations suggest that pigeon mutilations are at least partly linked with the cleanliness of the ground.

III.2.3. Feeding Ban

People who regularly feed pigeons are very much concerned with the physical state of pigeons. In addition to feeding, they often conduct care measures for pigeons (by treating atrophied claws and administering anti-parasite pills) and contribute in this way to better health conditions for pigeons (Colon and Lequarré 2013). By reducing the opportunities or time for interacting with pigeons, a feeding ban may have the unintended consequence of reducing the health status of those urban pigeons that are fed and protected by people who feed them regularly.

III.3. Effects on social perception resulting from public policies concerning pigeons

Public policies directly devoted to pigeon regulation also have some direct consequences on the social perception of pigeons.

III.3.1. Feeding ban

Communication programs have been implemented in many cities to discourage feeding of pigeons. In Paris, flyers are present in urban parks all over the city, stating that feeding animals is dangerous for both the animals and for humans (because of the concentrating effect of feeding, encouraging pathogen dissemination).

The nature of public biodiversity management often has a normative impact on public opinion and social perception (Skandrani et al. 2014). In this context, communication campaigns and legal

restrictive regulations on bird feeding are a kind of negative institutional communication that contributes to stigmatizing both pigeons and people who feed them (Colon and Lequarré 2013). These legal norms and communications enhance social tensions among people and in relation to pigeons.

III.3.2. Public dovecotes

On the other hand, public dovecotes are often considered by pigeon protectors as a “good” public policy, based on pigeons’ health and care. Therefore, these public dovecotes could anchor positive institutional messages, based on the existence of political commitment to the pigeon issue. In addition, public dovecotes may even convey the impression that the situation is under control. Indeed, in Paris, public dovecotes were first presented as “contraceptive dovecotes”, but now, they are presented as “mediation structures” between pigeons and city dwellers (Lizet and Millet 2012). Public dovecotes constitute a major factor for pigeon governance by encouraging the birds’ spatial distribution away from people and most likely affecting their sanitary conditions, and most likely have a social impact by acting as a reassuring measure that the pigeon issue is being dealt with.

III.4. Alternative public communication on pigeons

Despite all of the scientific results asserting the low potential health hazards of pigeons and their transmission risk to humans (see above), pigeons are still designated by officials and institutions as “nuisances” or “pests” based on epidemiological claims, thus further maintaining public concern about these issues (Jerolmack 2008).

However, the presence of pigeons in cities may offer some services to city-dwellers. First, by eating our refuse, urban pigeons provide a cleaning service (Haag-Wackernagel 1995), which has almost never been quantified and is ignored by both local authorities and city dwellers. Another potential service could also derive from the recovery of pigeon droppings collected in public dovecotes in the form of organic fertilizer or methane gas, as has been done for centuries with domestic pigeons.

Finally, pigeons could serve as indicators for environmental biomonitoring (e.g., Jacquin et al. 2013, Frantz et al. 2012).

Therefore, rethinking institutional communication on pigeons could help city dwellers reach their own opinions concerning pigeons, balancing their own apprehension with counteracting arguments presenting pigeons as socially useful. Such renewed communication could be more scientifically based, for instance concerning the levels of sanitary risks posed by pigeons; and more complete, for instance by presenting pigeons not only as “scroungers” but also as providers of ecosystem services.

IV. DISCUSSION

In our analysis, we considered the “pigeon problem” in the entirety of the socio-ecological system surrounding urban pigeons. By doing that, we changed the focus from a model dedicated to the ecology of pigeons to a model targeting social perception. The issue was revealed to be a question of public policies and communication between different stakeholders in the city. In this respect, we proposed to improve social perceptions of pigeons by considering several components of the system: 1) the reduction of local aggregations through measures that enhance the cleanliness of public places, city planning and the strategic location of public dovecotes (away from people), as well as a renewed communication with people who feed pigeons regularly; 2) a general improvement of pigeons’ sanitary conditions and resistance to parasites, through more hygienic nesting sites in dovecotes, an increased cleanliness of public places and more reliance on pigeon feeders; and 3) renewed institutional communication relating to pigeons, tending toward more scientifically based and complete messages.

Our results demonstrate the importance of considering urban biodiversity issues within the city’s broader socio-ecological system. Indeed, we showed that in the absence of such a holistic vision, political measures may have detrimental side effects. Consider, for instance, feeding restriction

policies, which are presented as a means to contain pigeon numbers. They also prevent feeder practices such as caring, which are beneficial in terms of pigeon health issues, and they increase the frequency of covert discharges of large amounts of food, which increases pigeon aggregation. Based on our model, we propose to switch to a participative management of urban pigeons, integrating feeders as co-carers instead of adversaries. In this context, public dovecotes could hold a pivotal role. For instance, authorizing the feeding of pigeons only close to dovecotes may reduce illegal pigeon feeding elsewhere. By feeding close to dovecotes, regular feeders of pigeons would also contribute to maximizing the dovecotes' efficiency in terms of pigeon aggregation away from people and in terms of pigeons' health improvement. This would in turn enhance the public perception of pigeons as controlled and healthy. Finally, such co-management practices would offer opportunities for communication between city dwellers and feeders on the pigeon issue. They could broaden comprehension and maybe even create new social links around the urban pigeon (Jerolmack 2013), thus contributing to fostering community cohesion (Jordan 2003, Light 2000). Rather than feeling threatened by pigeons or uneasy, "[...] participatory engagement can empower communities to work toward positive new trajectories." (Gobster 2005: 268).

More generally, our model highlights the importance of institutional messages when dealing with biodiversity issues. Institutions convey messages to the public in two ways: explicitly, through official communication (poster campaigns, mass media etc.), and also implicitly through policy measures (current regulations, city planning etc.). Because they are delivered by public institutions, these explicit/implicit messages orientate people's perceptions and opinion (Flynn and Goldsmith 1994), whatever the direction: for example, by enhancing people's discomfort with urban biodiversity when implementing stigmatizing legal measures as with pigeons, or on the contrary by playing a mediator role. Such high consequences of institutional communication in creating opinion should encourage public authorities to use public communication with extreme caution. This is particularly tricky in questions concerning complex interactions between humans and urban biodiversity, when communication often insists only on specific negative components of these relations. However,

communication that is not based on consensual and validated scientific data (or, in the absence of consensus, on all scientific data) decreases the public confidence towards scientists and public authorities (e.g., Bradshaw and Borchers 2000).

Furthermore, our model highlights the detrimental consequences of stigmatization and fear-based messages (see Fritsche et al. 2010). Concerning pigeons, institutional communication indeed focuses on health hazards. Generally speaking, raising public anxieties and using fear-based communication may call the attention of people to the problem (Gobster 2005). However, these ‘fear appeals’ fail to ensure long-term support and are effective only when their recipients (city dwellers) have the ability to enact change and affect the situation (Witte and Allen 2000). Playing on people’s anxieties may also have several negative social repercussions (Hastings et al. 2004). This may first encourage advocacy groups to thwart control efforts (Williams 2002) such as pigeon feeders and the consequences of their secret food discharges. These advocacy groups may in turn become stigmatized by dismissive institutional messages even without any scientific evidence of the reality of their negative impact. Finally, this pejorative marking may quickly degenerate into opposing group distinctions, where group membership inspires stereotypes and prejudice towards the out-group, thus favoring social conflicts (Koger and Winter 2012, Whitley and Kite 2006, Winter 2006, Tajfel and Turner 1986). Another negative effect of fear-based communication relies on ethics, as it may negatively affect those groups who are unfamiliar with urban biodiversity – i.e., city dwellers in general (Miller 2005), children or people already facing anxiety about animals (Bixler and Floyd 1997) – and hence further separate people from positive experiences and interactions with natural elements of the environment (Dunn 2006). Finally, the widespread perception of urban species as a nuisance may influence the way people perceive and experience their urban environment as a threat and foster the current culture of fear in our society (Gobster 2005).

In this paper, we illustrated how a holistic view of the complex system linking ecological, social and public realms allows the proposal of innovative solutions to solve conflicts between urban biodiversity and civil society. We call for positive attitudes challenging most current management

policies and communication on urban biodiversity. Amongst these, we suggest new governance practices including all involved stakeholders, together with the inclusion of urban biodiversity upstream in planning and decision-making.

REFERENCES

- Baldaccini N.E. 1999. La sterilizzazione come metodo di controllo delle popolazioni urbane di Colombo: una strada da perseguire? *Disinfezione e Igiene Ambientale* 2: 13-17.
- Baldaccini N.E., Giunchi D., Mongini E., Ragionieri L. 2000. Foraging flights of wild rock doves (*Columba l. livia*): a spatiotemporal analysis. *Italian Journal of Zoology* 67:371–377.
- Bevan R.D.R. 1990. The costs of Feral Pigeons. British Ornithological Union, Proceedings of a Symposium, October 1990, ADAS/British Ornithologists' Union, London: 10–11.
- Bixler R.D. and M.F. Floyd. 1997. Nature is scary, disgusting, and uncomfortable. *Environment and Behavior* 29(4): 443-467.
- Bradshaw G.A. and Borchers J.G. 2000. Uncertainty as Information. Narrowing the science-policy gap. *Ecology and Society* 4(1): 7.
- Buijs J.A., Van Wijnen J.H. 2001. Survey of Feral Rock Doves (*Columba livia*) in Amsterdam, a Bird-Human association. *Urban Ecosystems* 5(4):235-241.
- Caswell H. 1989. Matrix population models: construction, analysis and interpretation, first edition. Massachusetts: Sinauer, Sunderland.
- Clergeau P. 2007. Une écologie du paysage urbain. Rennes : Edition Apogée.
- Colon P-L. 2007. Autour des Pigeons. Etude Anthropologique des Relations entre des Savoirs et des Pratiques de l'Animal à partir d'un projet de Recherche Pluridisciplinaire. Mémoire de Licence Université de Liège. Unpublished Data.
- Colon P. L. and Lequarré N. 2013. Le nourrissage des pigeons dans la région parisienne. *Ethnologie française* XLIII: 153-160.

- Dunn R.R., Gavin M.C., Sanchez M.C., Solomon J.N. 2006. The pigeon paradox: dependence of global conservation on urban nature. *Conservation Biology* 20(6): 1814-1816.
- Evans K.L., Hatchwell B.J., Parnell M., Gaston K.J. 2010. A conceptual framework for the colonization of urban areas: the blackbird *Turdus merula* as a case study. *Biological Reviews* 85: 643–667.
- Fall M.W. and Jackson W.B. 2002. The Tools and Techniques of Wildlife Damage Management – Changing Needs: an Introduction. *International Biodeterioration and Biodegradation* 49: 87–91.
- Flynn L.R. and Goldsmith R.E. 1994. Opinion leadership in green consumption: an explanatory study. *J. Social behavior and personality* 9: 543-553.
- Frantz A., Pottier M-A., Karimi B., Corbel H., Aubry E., Haussy C., Gasparinin J., Castrec-Rouelle M. 2012. Contrasting Levels of Heavy Metals in the Feathers of Urban Pigeons from Close Habitats Suggest Limited Movements at a Restricted Scale. *Environmental Pollution* 168:23-28.
- Fritsche I., Jonas E., Niesta Kayser D., Koranyi N. 2010. Existential threat and compliance with pro-environmental norms. *Journal of Environmental Psychology* 30: 67-79.
- Gasparini J., Erin N., Bertin C., Jacquin L., Vorimore F., Frantz A., Lenouvel P., Laroucau K. 2011. Impact of Urban Environment and Host Phenotype on the Epidemiology of Chlamydiaceae in Feral Pigeons (*Columba livia*). *Environmental Microbiology* 12:3186-93.
- Giunchi D., Baldaccini N. E., Sbragia G., Soldatini C. 2007. On the use of Pharmacological Sterilisation to Control Feral Pigeon Populations. *Wildlife Research* 34(4):306-318.
- Giunchi D., Albores-Barajas Y.V., Baldaccini N.E, Vanni L., Soldatini C. 2012. Feral Pigeons: Problems, Dynamics and Control Methods. In : *Integrated Pest Management and Pest Control - Current and Future Tactics*. M.L. Larramendy and S. Soloneski Eds. InTech. DOI: 10.5772/1383. pp 215-240.
- Givois E. 2009. Les pigeons dans Le Figaro de 1861 à 1942. Unpublished Data.
- Gobster P. H. 2005. Invasive species as ecological threat: is restoration an alternative to fear-based resource management? *Ecological Restoration* 23: 261-270.
- Gouabault E., Burton-Jeangros C. 2010. L'Ambivalence des Relations Humain-Animal. Une Analyse Socio-Anthropologique du Monde Contemporain. *Sociologie et Sociétés* 42(1): 299-324.

Grimm N. B., Grove J.M., Pickett S.T.A., Redman C.L. 2000. Integrated approaches to long-term studies of urban ecological systems. *BioScience* 50:571-584.

Haag-Wackernagel D. 1995. Regulation of the Street Pigeon in Basel. *Wildlife Society Bulletin* 23(2):256-260.

Haag-Wackernagel D. 1997. Sociocultural Reasons for the Pigeon Problem]. *Deutsche Tierärztliche Wochenschrift* 104(2):52-7.

Haag-Wackernagel D. 2000. Behavioural responses of the feral pigeon (Columbidae) to deterring systems. *Folia Zoologica* 49: 25–39.

Haag-Wackernagel D. 2002. Feral Pigeons: Management Experiences in Europe. *Atti 2° Convegno Nazionale sulla Fauna Urbana "Specie ornitiche problematiche: biologia e gestione nelle città e nel territorio"*, Firenze, 10 giugno 2000, ARSIA e LIPU. Regione Toscana, Firenze. M. Dinetti. 25-37.

Haag-Wackernagel D. and Moch H. 2004. Health Hazards Posed by Feral Pigeons. *Journal of Infection* 48(4): 307-313.

Haag-Wackernagel D. 2005. Parasites from Feral Pigeons as a Health Hazard for Humans. *Annals of Applied Biology* 147(2): 203-210.

Hastings G., Stead M., Webb J. 2004. Fear appeals in social marketing: Strategic and ethical reasons for concern. *Psychology and Marketing* 21(11):961-986.

Heppell S., Caswell H., Crowder L. 2000. Life histories and elasticity patterns: perturbation analysis for species with minimal demographic data. *Ecology* 81: 654–665.

Hetmański T. 2007. Dispersion asymmetry within a feral pigeon *Columba livia* population. *Acta Ornithol* 42:23–31.

Hetmański T., Bocheński M., Tryjanowski P., Skorka P. 2011. The effect of habitat and number of inhabitants on the population sizes of feral pigeons around towns in Northern Poland. *European Journal of Wildlife Research* 57:421–428.

del Hoyo J, Elliott A, Christie D. (eds.) 2005. *Handbook of the Birds of the World* vol. 10. Lynx Ediciones: Barcelona.

Jacob G, Prévot AC, Baudry E (in revision). The geographic scale of genetic differentiation in the feral pigeon (*Columba livia*): implications for management.

Jacquin, Récapet, Prévot-Julliard, Leboucher, Lenouvel, Erin, Frantz, Corbel, Gasparini 2013. A potential role for parasites in the maintenance of bird color polymorphism in cities. *Oecologia* 173:1089-1099.

Jacquin L., Cazelles B., A-C. Prévot-Julliard, Leboucher G., Gasparini J. 2010. Reproduction management affects breeding ecology and reproduction costs in urban feral pigeons (*Columba livia*). *Canadian Journal of Zoology* 88: 781-787.

Jerolmack C. 2007. Animal archeology: Domestic pigeons and the nature-culture dialectic. *Qualitative Sociology Review* III (1): 74-95.

Jerolmack C. 2008. How Pigeons Became Rats: The Cultural-Spatial Logic of Problem Animals. *Social Problems* 55(2): 72-94.

Jerolmack C. 2013. *The Global Pigeon*. Chicago: University of Chicago Press.

Johnston R.F., and Janiga M. 1995. *Feral Pigeons*. Oxford: Oxford University Press.

Jokimäki J., Suhonen J. 1998. Distribution and Habitat Selection of Wintering Birds in Urban Environments. *Landscape and Urban Planning* 39: 253–263.

Kalof L., Amthor R.F. 2010. Cultural Representations of Problem Animals in National geographic. *Etudes Rurales* 185 : 165-180.

Lequarré N. 2009. Projet « Pigeon en ville » Enquête anthropologique sur le nourrissage des pigeons à Paris et sa proche périphérie. Unpublished Data.

Lefebvre L. and Giraldeau LA. 1984. Daily feeding site use of urban pigeons. *Canadian Journal of Zoology* 61: 1425–1428.

Lizet B. and Millet J. 2012. Le pigeonnier public, à la croisée des utopies sur le vivant dans la ville. In : *Animal certifié conforme. Déchiffrer nos relations avec le vivant*, B. Lizet and J. Millet (Eds.). Paris : Dunod. 185-204.

Louv R. 2008. Last child in the woods - Saving our children from nature-deficit disorder. Algonquin Books.

Magnino S., Haag-Wackernagel D., Geigenfeind I., Helmecke S., Dovc A., Prukner-Radovic E., Residbegovic E., Ilieski V., Laroucau K., Donati M., Martinov S., Kaleta E.F. 2009. Chlamydial Infections in Feral Pigeons in Europe: Review of Data and Focus on Public Health Implications. *Veterinary Microbiology* 135(1-2):54-67.

McDonnell MJ. and Pickett STA. 1990. Ecosystem structure and function along urban–rural gradients: An unexploited opportunity for ecology. *Ecology* 71: 1231–1237.

McKinney M.L. 2002: Urbanization, Biodiversity, and Conservation. *BioScience* 52(10): 883-890.

Miller J.R. 2005. Biodiversity conservation and the extinction of experience. *Trends in Ecology & Evolution* 20: 430-434.

Møller A.P. 2008. Flight Distance of Urban Birds, Predation, and Selection for Urban Life. *Behavioral Ecology and Sociobiology* 63:63–75.

Mugerauer R. 2010. Toward a theory of integrated urban ecology: complementing Pickett et al. *Ecology and Society* 15(4): 31.

Nam D. H., Lee D.P., Koo T.H. 2004. Monitoring for lead pollution using feathers of feral pigeons (*Columba livia*) from Korea. *Environmental Monitoring and Assessment* 95: 13-22.

Ostrom E. 2009. A General Framework for Analyzing Sustainability of Social-Ecological Systems. *Science* 325: 419-422.

Pickett STA., Cadenasso M.L., Grove J.M., Groffman P.M., Band L.E., Boone C.G., Burch W.R., Grimmond S.B., Hom J., Jenkins J.C., Law N.L., Nilon C.H., Pouyat R.V, Szlavecz K., Warren P.S., Wilson M. 2008. Beyond urban legends: an emerging framework of urban ecology, as illustrated by the Baltimore ecosystem study. *Bioscience* 58:139-150.

Pimentel D., Lach L., Zuniga R., Morrison D. 2000. Environmental and Economic Costs of Nonindigenous Species in the United States. *BioScience* 50(1): 53-65.

- Ragni B., Velatta F., Montefameglio M. 1996. Restrizione dell'Habitat per il Controllo della Popolazione Urbana di *Columba livia*. Controllo delle popolazioni ornitiche sinantropiche: "problemi e prospettive", ISS/WHO/FAO-CC/IZSTE/ Roma, October 1993. 106-110.
- Récapet C., Dauphin L., Jacquin L., Gasparini J., Prévot-Julliard A-C. 2013. Eumelanin-based Colouration Reflects Local Survival of Juvenile Feral Pigeons in an Urban Pigeon House. *Journal of Avian Biology* 44: 001–008.
- Rose E., Nagel P., Haag-Wackernagel D. 2006. Spatio-temporal use of the urban habitat by feral pigeons (*Columba livia*). *Behavioral Ecology and Sociobiology* 60: 242–254.
- Rosenzweig M. L. 2003. Reconciliation Ecology and the Future of Species Diversity. *Oryx* 37(2):194–205.
- Sacchi R., Gentili A., Razzetti E., Barbieri F. 2002. Effects of Building Features on Density and Flock Distribution on Feral Pigeons *Columba livia* var. *domestica* in an Urban Environment. *Canadian Journal of Zoology* 80:48-54.
- Sæther B., Bakke Ø. 2000. Avian life history variation and contribution of demographic traits to the population growth rate. *Ecology* 81: 642–653.
- Senar J. C., Carrillo J., Arroyo L., Montalvo T., Peracho V. 2009. Estima de la abundancia de palomas (*Columba livia* var.) de la ciudad de Barcelona y valoración de la efectividad del control por eliminación de individuos. *Arxius de Miscel·lània Zoològica* 7(1):62-71.
- Serpell J.A. 2004. Factors Influencing Human Attitudes to Animals and their Welfare. *Animal Welfare* 13: 145-151.
- Skandrani Z., Lepetz S., Prévot-Julliard A-C. 2014. Nuisance Species: beyond the ecological perspective. *Ecological Processes* 3(3): 1-12.
- Sol D. and Senar J.C. 1992. Comparison between two censuses of Feral Pigeon *Columba livia* var. from Barcelona: an evaluation of seven years of control by killing. *Butlletí del Grup Català d'Anellament* 9:29-32.

Soldatini C., Mainardi D., N.E. Baldaccini, Giunchi D. 2006. A temporal analysis of the foraging flights of feral pigeons (*Columba livia f. domestica*) from three Italian cities. Italian Journal of Zoology 73: 83-92.

Stearns S., Kawecki T. 1994. Fitness sensitivity and the canalization of life-history traits. Evolution 48: 1438–1450.

Stokes D. L. 2007. Things We Like: Human Preferences among Similar Organisms and Implications for Conservation. Human Ecology 35:361–369.

Vuorisalo T., Lehtikainen E., Lahtinen R. 2001. History of domestic and feral pigeons (*Columba livia*) in Finland before 1900 AD. Ornis Fennica 78: 119-126.

Vuorisalo T., Andersson H., Hugg T., Lahtinen R., Laaksonen H., Lehtikainen E. 2003. Urban development from an avian perspective: causes of hooded crow (*Corvus corone cornix*) urbanisation in two Finnish cities. Landscape and Urban Planning 62:69–87.

Williams T. 2002. America's largest weed. Eucalyptus has its defenders, but today, 150 years after these "wonder trees" were first brought to coastal California, their dark side is coming to light. Audubon 104 (Jan/ Feb) <http://magazine.audubon.org/incite/incite0201.html>; accessed November 2013.

Witte K. and Allen M. 2000. A meta-analysis of fear appeals: Implications for effective public health campaigns. Health Education and Behavior 27(5):608-632.

Zucconi S., Galavotti S., Deserti R. 2003. I Colombi in Ambiente Urbano. Disinfestazione 9-21.

CONCLUSION

In this Ph.D. thesis, I propose a new social-ecological model of urban thinking: namely that urban biodiversity follows its own rules in spreading in anthropic habitats and develops its own specific characteristics in cities. These ecological and behavioral features further dynamically interact with social, political, economic factors, by both influencing and being influenced by the human environment, and thus produce specific nature perceptions and representations. Delving deeper into these interactions provides better comprehension of where and why biodiversity comes into contradiction with human definitions of landscape and society-nature relations. Accordingly, understanding these social processes as well as the ecology and behavior of species allows us to determine the accurate ecological aspects to act on, and thus, the accurate measures to undertake at the socio-political level to increase social acceptance. Similarly, acknowledging the multiple levels – i.e., institutional communication, policy making, biodiversity management or control, and situational context – through which nature perceptions and society-environment relations are mediated and sometimes contradictorily communicated, may help identify and neutralize further conflict-stirring elements.

Through the case study of the urban pigeon, I highlight that an important feature at stake in humans' relation to and ordering of nature is the definition of human identity and the definition of related rights on the environment, in comparison to the living around them. This definition act is an ongoing process depending on the multiple interactions of humans with biodiversity. Yet, as it appears in the research presented here, public stakeholders, such as decision makers and all those dealing with nature at a public level (e.g., scientists, educators, and naturalist associations), bear weight on lay people's stances; to this extent, they hold a particular responsibility in the human auto-definition process. Further, I suggest that in the current trend to reconsider/renegotiate human relations to biodiversity and bring them toward new, more sustainable directions, it is also necessary to allow and create the conditions for all people to participate in this process by giving them their own, free space of interaction with nature.

Governance models, relying on the type of interdisciplinary framework advocated in this thesis, may be more likely to overcome impediments to the acknowledgement of all actors as co-inhabitants and companion species in the hybrid ecological metropolis (Lestel 2010, Philo and Wolch 1998, Haraway 1991). This approach remains normative in its purpose of conservation biodiversity (as is the general conservation paradigm, Sandbrook et al. 2013). However, it stands out from top-down approaches precisely through its regard in reaching its goals of all stakeholders and their agency. The application of such a framework could further be tested on environmental issues and mediation in biodiversity-human conflicts in non-urban habitats that are related to the use of resources and economic development aims. These motives could indeed also be considered the only visible part of a much more complex problem that entails diverging nature understandings and landscape ascriptions, i.e., what is the proper use of a given space, who (humans, non-humans) has rights upon the territory and why, who has decision power, etc. The in-depth clarification of these representations and the multiple underlying system dynamics may contribute to reveal, beyond material competitions with biodiversity and claims on nature, further social issues at stake such as perceptions of social injustice or others, thus allowing us to more accurately grasp the problem and perhaps find more lasting mediation solutions.

RESUME VERSION LONGUE

Introduction

Le terme 'nature' regroupe deux idées (Gandy 2006). D'une part, il fait référence aux caractéristiques biotiques et abiotiques de l'environnement, allant des organismes (plantes, animaux, corps humains) au système du vert tel que les jardins, réserves ou écosystèmes, en incluant les aspects géologiques, climatiques, les processus hydrologiques et d'autres facteurs biologiques et géologiques (Grimm et al. 2000). D'autre part, le terme 'nature' se rapporte aux interprétations humaines de ces patterns biogéophysiques (Gandy 2006). Des comparaisons interculturelles ont démontré l'absence d'unanimité dans les représentations humaines de cette réalité (Griffith et Poulter 2000). Dans la pratique, les éléments concrets et abstraits sont entremêlés, dans la mesure où les discours et les différentes compréhensions de la nature sont mobilisés dans et contribuent à la production des environnements (Swyngedouw 1999), tout en étant réciproquement influencés par les forces biogéophysiques et les dynamiques écosystémiques (Grimm et al. 2000). Les 'natures' et les environnements sont ainsi des constructions socio-physiques : pas uniquement l'espace bâti mais tous les changements dans l'utilisation des territoires, les parcs urbains, les réserves naturelles, la consommation des ressources, l'introduction ou la domestication d'espèces etc. sont le résultat de processus historiques constitués à travers les caractéristiques environnementales biophysiques et le contenu socio-culturel relatif à ces éléments (Haraway 1991).

Les représentations de la nature et la définition corollaire des paysages déterminent le placement conceptuel des espèces, y compris des humains, dans et en relation avec ces environnements. Elles influencent également l'ordonnement des espèces les unes par rapport aux autres (Brownlow 2000). Ainsi, l'inclusion ou l'exclusion de certaines espèces animales et leur traitement avec affection ou dégoût dépend dans beaucoup de sociétés présentes et passées de leur placement à l'intérieur d'une certaine cosmogonie (Griffith et Poulter 2000). De la même façon, les schémas scientifiques d'interprétation de la nature, tels que le concept de 'niche écologique' délimitent la place distincte d'un organisme à l'intérieur de classifications écologiques et sa place appropriée dans les écosystèmes (Philo et Wilbert 2000).

Il est aujourd'hui de plus en plus admis que les dynamiques naturelles ne sont pas séparées des processus sociaux. Il est ainsi désormais commun de parler de socio-écosystèmes (Berkes et Folke 1998) et de définir la biodiversité comme tout le monde biotique, humain et non-humain, pour insister sur le concept des « humains-dans-la-nature ». L'écologie classique ou les approches traditionnelles des dynamiques des écosystèmes considérant les humains externes au système, sont de plus en plus jugées obsolètes (Campbell 2010, Grimm et al. 2000) et sont désormais remises en question par de nouveaux cadres analytiques. La théorie de la résilience, par exemple, inclut les humains en tant qu'agents du changement environnemental et souligne les liens réciproques entre les dynamiques des écosystèmes et les dynamiques sociales (Folke 2006).

Ces développements conceptuels ont été stimulés par les conséquences dramatiques sur l'environnement de l'augmentation des populations humaines et du processus drastique d'urbanisation, en termes d'appauvrissement de la diversité biologique et d'extinction potentielle de milliers d'espèces (Dunn et al. 2006, Young et al. 2006, Heynen 2006). En parallèle, les réserves naturelles, corollaire de la vision « humans-out » (Maffi et Woodley 2010) sont jugées désormais insuffisantes à la conservation de la biodiversité (Miller et Hobbs 2002). Cependant, penser la nature et les interdépendances humains-nature en ces nouveaux termes implique une reconsidération et une réorganisation fondamentales des paysages réels et imaginés, de même qu'une redéfinition des relations entre les composantes humaines et non-humaines de la nature (Brownlow 2000). C'est d'ailleurs dans les espaces anthropiques que la restauration de la nature et de la diversité écologique est actuellement entreprise (Dunn et al. 2006, Rosenzweig 2003). Plus particulièrement, dans cette nouvelle perspective et en postulant que les écosystèmes urbains peuvent maintenir un mix cosmopolite d'espèces (Francis et Chadwick 2012), les éléments de la biodiversité sont de plus en plus considérés comme des habitants urbains (Gandy 2006).

Le fait de vouloir répondre à la crise écologique globale en reconnaissant un continuum entre la nature et les sociétés humaines s'appuie cependant sur une nouvelle conceptualisation des relations

humains-nature, une révision des valeurs et un ajustement des modes de vie des sociétés occidentales (Maris et Béchet 2010). En effet, en plus des volontés de restauration, la conservation de la biodiversité insiste sur la nécessité de lutter contre l'aliénation de la nature dans les sociétés occidentales et d'améliorer les connexions individuelles avec celle-ci, notamment en encourageant les expériences directes avec la nature urbaine (Dunn et al. 2006, Miller 2005). Avec des populations humaines bien plus importantes qu'en milieu rural, les milieux urbains sont des espaces où ces transformations et les thématiques socio-environnementales relatives sont vécues de façon la plus vive (Heynen 2006).

Cependant, le glissement des modèles mentaux vers une perspective des « humains-dans-la nature » et les changements corollaires des descriptions et conceptions des paysages urbains, ne sont pas nécessairement adoptés de façon uniforme par tous. Par conséquent, on observe aujourd'hui une diversité croissante de modes de représentation et de valorisation de la nature, qui peuvent entrer en conflit de différentes façons (Maris et Béchet 2010) : tout d'abord, les citoyens sont moins familiers avec la biodiversité qu'il y a 25-30 ans (Ditchkoff et al. 2006) et parfois peu tolérants envers les éléments naturels, peut-être à cause d'une perte d'interactions avec la nature (Jerolmack 2008). En l'absence d'animaux et de nature en ville, ils ont en revanche été forcés pendant longtemps de s'appuyer sur des images relayées par différents médias (livres, télévision, zoos etc.) de ces 'autres' non-humains, représentés comme 'sauvages' et distincts des humains (Browlow 2000). La nature non apprivoisée - surtout les animaux - sont ainsi souvent encore vécus par comme n'étant pas à leur place, comme désordre social (Douglas 1966) et transgressifs dans des espaces dévolus aux humains (Skandrani et al. 2014, Jerolmack 2008). Ces représentations résiduelles de la nature entrent inévitablement en collision avec les efforts institutionnels de restauration de la nature urbaine, qui augmentent les opportunités de rencontres entre citoyens et biodiversité. Pour citer un exemple (hors de la ville), les conflits sociaux autour des loups en milieu rural sont expliqués sur la base non pas d'attitudes antagonistes envers l'espèce en soi, mais de conceptions du loup comme animal fondamentalement sauvage et ainsi acceptable dans les espaces naturels mais non ruraux (Figari et

Skogen 2011). Dans le contexte de la conservation également, des conceptions divergentes peuvent mener à des interactions complexes entre les différents acteurs (Buijs et al. 2011). En effet, malgré un objectif final commun (la conservation de la biodiversité), les représentations individuelles vont de la valorisation utilitariste de la nature, corollaire de la dichotomie historique humains-nature, à des perspectives plus holistiques incluant la valeur intrinsèque et non-instrumentale des espèces, des écosystèmes ou des processus écologiques qui ne sauraient être réduits à satisfaire des fins humaines (Maris et Béchet 2010). Ainsi, bien que la protection de la nature, des paysages et de la biodiversité soit une thématique importante dans l'opinion publique, il peut parfois y avoir d'intenses résistances à la mise en place de mesures, quand des discours parallèles sur la nature peuvent donner des objectifs de conservation conflictuels (Gustafsson 2013, Buijs et Elands 2013).

Un défi majeur est ainsi aujourd'hui de développer des modèles de gouvernance qui rendent possible la gestion de tels changements conceptuels et qui permettent la résolution des conflits, de manière à garantir la capacité des systèmes à promouvoir des relations socio-écologiques apaisées (Folke 2006). Le prochain challenge est donc de gérer des transitions vers de nouvelles configurations plus désirables telles que la coexistence socio-écologique et de stimuler l'action collective vers des chemins de développement plus durable. En effet, les efforts institutionnels et de conservation visant à 'réintroduire' la nature présupposent l'existence d'une 'place' pour la nature, non seulement matérielle mais aussi et surtout conceptuelle (Brownlow 2000). La définition de cette place dépend fortement des conceptions de la nature, des valeurs et des relations spatiales corollaires alors qu'une incompatibilité entre ceux-ci est au cœur des conflits sociaux autour de la biodiversité (Maris et Béchet 2010). Dans le but d'élaborer des modèles de gouvernance adaptative, les priorités de recherche doivent ainsi prêter attention au caractère central des conceptions sur la nature et des valeurs en jeu (Maris et Béchet 2010), les deux étant respectivement les dimensions interdépendantes cognitive et normative des représentations sociales (Keularz et al. 2004). Des cadres d'analyse des systèmes socio-écologiques existent, qui analysent les dynamiques entre les

variables écologiques et sociales à différents niveaux (Ostrom 2009), ou, comme la gestion adaptative (« adaptive management », Holling 1978), qui prend en compte les relations entre les composantes du système socio-écologique à gérer dans la formulation d'hypothèses et de modèles. Cependant, les représentations de la nature sont rarement interrogées. Pourtant, en adéquation avec le pragmatisme environnemental (Minteer et Collins 2005), la gestion ajustative (« adjustive management », Maris et Béchet 2010) et d'autres (Buijs et Elands 2013), nous soutenons que, les modèles de gouvernance doivent clarifier les conceptions sous-jacentes plus générales sur la nature. En adéquation avec la théorie des représentations sociales, nous proposons en outre de mettre en évidence non seulement le contenu des conceptions de nature, mais également comment celles-ci émergent, et d'analyser de façon critique les discours déterminant leur articulation (Moscovici 2000). Dévoiler les processus de leur production et leurs voies de transmission est en effet crucial pour anticiper en amont la génération de représentations conflictuelles de la nature et d'obstacles potentiels à la conservation. Ces représentations de la nature et des relations appropriées entre la société et son environnement sont en effet des interprétations développées dans un contexte social et un espace-temps donnés (Buijs et al 2011). Elles sont produites à travers la communication, dans différentes pratiques sociales, et dépendent des connaissances, de l'éducation et des groupes sociaux auxquels les personnes participent (Moscovici 2000). Analyser ces processus implique ainsi de considérer tous les acteurs concernés, de même que leurs dynamiques interactives et influences réciproques (Gobster et al. 2007), à travers lesquelles du sens est attribué à l'environnement (Mugerauer 2010). De plus, selon la théorie de l'acteur-réseau (Latour 1993), aussi bien les humains que les non-humains sont impliqués et détiennent une « agency » dans cette production de sens : la société civile, les institutions mais également la nature et la biodiversité. En effet, les représentations de la biodiversité sont contingentes des institutions et de leur pouvoir de codification (Herda-Rapp et Goedecke 2005, Grimm et al. 2000). Ces institutions sont elles-mêmes constamment redéfinies et réinventées de manière à co-évoluer avec un environnement dynamique, comme le démontre la transition du 'gouvernement' vers la 'gouvernance' ayant lieu dans plusieurs pays (Duit et al. 2010).

Plus important encore, les espèces animales et végétales ne sont pas uniquement un produit mais des acteurs, ou ‘actants’ (Latour 1993) essentiels du système socio-écologique ; ils influencent les comportements et en forcent des adaptations ou des ajustements d’économies municipales entières (Robbins 2007).

L’amélioration de notre savoir sur la co-construction des conceptions sur la nature et des relations nature-société pourrait donc être un outil puissant pour le développement de visions partagées et la mitigation de résistances sur les thématiques de conservation.

Cette thèse de doctorat propose des réflexions théoriques sur la gestion de conflits autour de la conservation et de la gouvernance de la biodiversité dans des lieux jusque récemment exclusivement pensés pour les humains. L’objectif général de mon travail a été de souligner dans quelle mesure les représentations de la nature peuvent entraver des efforts de conservation et à travers quels processus socio-écologiques ces dernières sont établies. Plus précisément, j’ai étudié les interactions réciproques entre représentations sociales de la biodiversité et dynamiques socio-écologiques, ou comment certaines conceptions sur la biodiversité sont activement produites et véhiculées par des dynamiques d’interactions entre les composantes humaines et non-humaines de la nature. De plus, j’ai montré dans quelle mesure ces conceptions peuvent être à l’origine de réticences sur des sujets environnementaux, en particulier quand de nouvelles conceptions impliquent des redéfinitions de l’espace et des relations humains-biodiversité-environnement.

Ces réflexions théoriques s’appuient sur des travaux empiriques de recherche en milieu urbain. Ici, j’ai considéré les écosystèmes urbains comme des socio-écosystèmes composés de dynamiques sociales, politiques/institutionnelles et écologiques interconnectées. En cela, ces études s’inspirent de cadres d’analyse des systèmes socio-écologiques (Ostrom 2009), de la théorie de la résilience (Folke 2006), de la théorie de l’acteur-réseau (Latour 1994) et de la théorie des représentations sociales (Moscovici 2000). Excepté pour un cas, les recherches menées prennent les pigeons urbains (*Columba livia*) comme modèle d’analyse. Le pigeon urbain a en effet ceci de particulier qu’il n’a

jamais existé 'à l'état sauvage' et a toujours eu son habitat 'naturel' parmi les humains (Johnston et Janiga 1995). En tant qu'animaux domestiqués, les pigeons ont été dotés de valeurs symboliques (d'amour, paix et fertilité) sur la base de leurs caractéristiques visibles (et désirées) (Jerolmack 2008). Alors qu'ils ont été « créés » par les humains pour un usage domestique, ils se sont ensuite échappés puis ré-ensauvagés (ou 'féralisés'), et constituent ainsi ce qui pourrait être appelé un 'hybride' (*sensu* Latour), un produit de la nature et de la société, et même un double hybride (Jerolmack 2007). L'espèce est ainsi particulièrement intéressante dans ce travail, puisqu'il ne s'agit pas 'juste' d'un objet naturel mais d'un bon exemple à travers lequel la production socio-écologique de sens peut être étudiée.

Le travail de thèse est présenté sous la forme de 5 articles ou manuscrits, suivant le cheminement suivant :

1. La présence de la biodiversité en ville précède et conditionne sa problématisation ; elle constitue en cela un élément central à partir duquel les représentations de la biodiversité vont ensuite se développer. Cette présence n'est cependant pas fortuite. Ainsi, dans le premier article intitulé « Tolérance environnementale chez les oiseaux urbains : adaptation synanthropique ou plasticité phénotypique? », mes collègues et moi soulignons dans une perspective écologique, la « agency » des pigeons dans leur installation dans les espaces anthropiques. En étudiant la tolérance environnementale des pigeons, nous démontrons que ceux-ci tirent avantage de leurs propres caractéristiques au même degré que des particularités urbaines pour persister dans les villes.

2. Dans l'article « Espèces nuisibles : par-delà de la perspective écologique », nous utilisons le concept d'« espèces nuisibles » et les changements dans les images des pigeons pour démontrer que les représentations de la nature et de la biodiversité sont produites par des processus historiques et d'interactions inter-espèces, avec de multiples facteurs d'influence, d'« agences » et d'enjeux. Nous montrons en outre comment l'évolution de ces conceptions ou « socio-natures » (Swyngedouw

2004) sont au cœur de conflits contemporains au sujet des pigeons urbains dans de nombreuses métropoles.

3. Dans l'article « Ancrer le 'paradoxe du pigeon' : médiation des interactions avec la biodiversité ordinaire par le contexte public », nous illustrons ensuite, à travers une étude comportementale, les oppositions entre d'une part les encouragements officiels croissants pour une reconnexion avec la nature afin de renforcer la conscience environnementale, et d'autre part l'influence restrictive du contexte social normatif sur les interactions entre les humains et la nature urbaine au quotidien.

4. Dans l'article « Verdir la ville et ensuite ? Orientations similaires mais politiques publiques divergentes dans deux capitales européennes » nous nous détachons de l'exemple des pigeons urbains pour mettre en évidence, par une comparaison entre Paris et Berlin, comment différents discours institutionnels peuvent façonner les représentations de la nature : encouragement explicite de la restauration de la nature ou définition implicite des relations humains-nature à travers l'aménagement et la gestion des parcs urbains. Nous suggérons que des discours explicites et implicites contradictoires peuvent bloquer l'acceptation sociale de mesures institutionnelles de conservation en milieu urbain.

5. Enfin, dans l'article de conclusion « Modélisation d'un système socio-écologique urbain : vers une coexistence des citadins et des pigeons en ville », nous posons la question de la gestion et du contrôle des pigeons urbains et fournissons un exemple concret de médiation et de gouvernance intégrative dans un conflit social autour de la biodiversité urbaine, construit à partir des perceptions sur les pigeons et des facteurs d'influence sociaux et écologiques.

Les recherches présentées dans cette thèse sont intrinsèquement interdisciplinaires dans les méthodologies employées, empruntant à l'éthologie, la géographie animale, les sciences sociales, la psychologie sociale et la modélisation formelle. La thèse de doctorat est cependant avant tout ancrée dans le domaine de l'écologie. En effet, bien que ceci puisse être précisé et décliné plus en

avant en écologie humaine et comportementale, avec des objectifs de conservation et de gouvernance environnementale, je souhaite mettre l'accent sur l'intégration de la thèse dans le domaine de l'écologie de façon plus générale. En effet, dans la nouvelle perspective de l'humain-dans-la nature, la prochaine étape est de traduire les évolutions conceptuelles dans la redéfinition des disciplines scientifiques elles-mêmes. Dans la mesure où les humains à la fois impactent et répondent aux processus des écosystèmes (Chapin et al. 2010), et étant donnée l'importance primordiale de la prise de décision humaine sur les écosystèmes (Grimm et al. 2000), l'écologie ne peut plus être considérée comme la sphère des organismes non-humains et du milieu biogéophysique. Il ne s'agit pas là uniquement de reconnaître la pertinence (réelle) des recherches sociales sur des sujets environnementaux et de conservation (Sandbrook et al. 2013, Fazey et al. 2005), mais bien plus de formuler une nouvelle compréhension de l'écologie, comme une discipline intégrative, incluant humains et non-humains de façon égale, c'est-à-dire tout le monde biotique et leurs communautés interconnectées à l'intérieur de contextes géo-physico-chimiques et climatiques.

1. Tolérance environnementale chez les oiseaux urbains : adaptation synanthropique ou plasticité phénotypique?

Historiquement considérés comme inappropriés à la biodiversité, les écosystèmes urbains sont aujourd'hui reconnus pour maintenir un large éventail d'espèces précédemment associées avec les paysages ruraux, telles que les petits mammifères, les oiseaux et l'herpétofaune. Les exemples classiques incluent le pigeon biset (*Columba livia*) et les moineaux domestiques (*Passer domesticus*), mais d'autres passeriformes, écureuils, renards et petits et moyens mammifères se sont également acclimatés avec succès aux espaces urbains et suburbains (Francis et Chadwick 2012). Les oiseaux en particulier, plus mobiles que les mammifères et l'herpétofaune, investissent de façon croissante les environnements urbains et pourraient devenir des représentants phares de la biodiversité urbaine. Suivant les espèces, leur présence est cependant encouragée, ignorée ou rejetée par les humains des

viles (Campbell 2010). La connaissance de leur comportement et de leurs traits d'histoire de vie les plus caractéristiques s'avère nécessaire pour comprendre ensuite leurs interactions et leurs comportements, en interrelation avec les citadins (Philo et Wilbert 2000). Connaître les vulnérabilités des espèces peut par exemple permettre le développement de stratégies favorisant leur présence en milieux anthropiques ; vice-versa, identifier les comportements humains à la base des enjeux dans des conflits humains-biodiversité pourrait aider à diminuer ceux-ci.

Les espèces animales urbaines et péri-urbaines sont exposées à une série de nouveaux stress environnementaux par rapport à leurs congénères ruraux, facteurs qui diffèrent également des pressions sélectives sous lesquelles elles ont évolué. Par conséquent, pour s'installer dans des milieux urbains, les espèces doivent souvent modifier leurs comportements (Stephen et al. 2006).

Les changements comportementaux peuvent concerner les patterns d'activité temporels, les distributions spatiales, les stratégies d'alimentation et de reproduction (Francis et Chadwick 2012). Dans ce premier article, nous nous intéressons de plus près à ces adaptations comportementales aux environnements urbains, pour essayer de comprendre les mécanismes à la base de ces adaptations. Plus précisément, nous y discutons si ces réponses adaptatives sont le résultat d'une microévolution en contexte urbain ou de la plasticité comportementale des espèces. Nous utilisons les pigeons urbains comme système modèle. Nous avons mené des expériences comportementales avec quatre groupes différents de pigeons bisets *Columba livia* : des pigeons urbains 'ré-ensauvagés' (libres et en captivité) et des pigeons voyageurs domestiques (libres et en captivité). Pour chaque groupe, nous avons mené trois mesures comportementales standardisées de tolérance environnementale : la prise de risque exprimée dans des distances de fuite courtes par rapport à un prédateur potentiel, la néophobie, et l'aptitude à la résolution d'un problème.

Nos résultats n'indiquent aucun effet significatif du statut des pigeons (domestique versus ré-ensauvagé) sur les comportements observés. En revanche, les conditions écologiques (captif versus libre) affectent nos trois mesures comportementales, confirmant que la tolérance environnementale

de cette espèce à la ville semble être l'expression de leur plasticité phénotypique, plutôt que le résultat de la domestication, comme souvent supposé.

Les stratégies comportementales des pigeons urbains (notamment vis-à-vis des citadins) ne semblent donc pas influencées directement par leur histoire de domestication. Mais qu'en est-il de la relation inverse, c'est-à-dire des représentations que se font les humains des pigeons urbains ? Les résultats de cette étude font l'objet du second article.

2. Espèces « nuisibles » : par-delà de la perspective écologique

Lorsque les espèces animales colonisent de nouvelles niches en s'adaptant et investissant des milieux différents de leurs écosystèmes d'origine, elles peuvent entrer en contradiction visible avec les définitions humaines des paysages et de leurs espèces attirées. Les villes en particulier sont sujettes à un processus d'ordonnancement qui détermine clairement ce qui peut être inclus et ce qui n'en fait pas partie (Griffith et Poulter 2000). Dans ces cas, les espèces qui dérangent ces relations spatiales sous-jacentes aux qualifications humaines de la biodiversité, sont facilement étiquetées comme des 'nuisances' (Jerolmack 2008, Philo et Wilbert 2000). Ces classifications ne sont pas sans rappeler parfois les mythes fondateurs des sociétés occidentales, des Plaies d'Égypte à l'Odyssée ou encore le Joueur de flûte de Hamelin, qui révèlent les peurs latentes ravivées par la perturbation de l'ordre établi (Claeys et Sirost 2010). Cependant, plus généralement, nous pouvons nous demander quels sont les enjeux derrière l'ordonnancement spatial de la biodiversité.

Le deuxième article vise ainsi à éclairer le concept d' 'espèce nuisible', non pas d'un point de vue écologique, mais dans une perspective interprétative de ces classifications environnementales comme socialement et historiquement fondées (Fine 1997). Nous proposons une explication nouvelle et complémentaire des espèces nuisibles dans le concept de 'socio-nature', à partir de l'exemple des pigeons urbains.

Dans un premier temps, nous analysons dans une perspective historique les perceptions des pigeons comme nuisance, ainsi que les relations écologiques, sociales, économiques et politiques en jeu dans ces perceptions. Cette analyse nous permet de clarifier les types de discours sur et à propos des non-humains de façon générale qui sont mobilisés.

Cependant, en mettant l'accent uniquement sur les moyens par lesquels les espèces animales sont représentées, l'on pourrait croire que ces espèces sont des surfaces passives sur lesquelles les groupes humains projettent des significations (Philo et Wilbert 2000). Au contraire, nous montrons comment les animaux eux-mêmes figurent de façon dialectique dans ces pratiques et dans quelle mesure ils déstabilisent ou résistent les ordonnancements humains. En particulier, nous soulignons comment les caractéristiques comportementales et l'écologie des pigeons guident et contraignent les représentations sociales qui leur sont attribuées.

Enfin et dans un troisième aller-retour entre humains et animaux urbains, l'identité de chaque acteur impliqué dans ces discours ne se forme pas indépendamment des relations que celui-ci a construit avec l'autre pour se joindre au reste ; au contraire, elle se constitue à travers ses relations à l'autre (Robbins 2007). En nous appuyant sur la théorie des représentations sociales, nous illustrons ainsi des problématiques de définition de l'identité humaine comme enjeu de la construction des pigeons comme nuisibles.

Par ce travail autour du pigeon, nous donnons un exemple de contexte dans lequel la présence de biodiversité urbaine est débattue actuellement dans nos villes. Nous montrons l'importance de l'histoire et des relations entre humains, dans la définition même de la place donnée à certaines espèces dans les villes. Ces considérations sont également intéressantes à prendre en compte dans le contexte plus général de gestion de la biodiversité urbaine, dont il est question dans le troisième article.

3. Entre politiques publiques et représentations sociales : importance cachée de la communication implicite de valeurs

Avec la reconnaissance grandissante de l'empreinte humaine sur la dégradation de la biodiversité (Young et al. 2006), la société civile et les acteurs scientifiques et institutionnels ont progressivement appelé à plus d'attitudes respectueuses de l'environnement, en contribuant ainsi au développement de nouvelles conceptions des relations nature-société (Campbell 2010, Heynen 2006, Grimm et al. 2000, Wolch et al. 2000, Berkes and Folke 1998). Comme discuté précédemment à travers l'exemple des conceptions culturelles des pigeons comme nuisance, les représentations communes de la nature font cependant parfois encore écho à un héritage conceptuel historique qui divise les humains du reste du vivant, et dont les mêmes acteurs promouvant de nouveaux modes de penser la nature ne sont pas nécessairement exempts. Reconnaître ces conceptions et valeurs divergentes de la nature est utile pour comprendre les réactions de certaines personnes aux mesures officielles de conservation, réactions qui peuvent mettre en péril la légitimité ou l'efficacité de nouvelles stratégies de gestion (Buijs et Elands 2013). Parmi celles-ci, deux sont de plus en plus promues dans le contexte urbain : d'une part la restauration de la nature urbaine à travers la gestion différenciée et la favorisation de la biodiversité spontanée (Rosenzweig 2003), et d'autre part l'augmentation de l'intérêt pour et du lien des citoyens avec la nature (Dunn et al 2006, Miler 2005) dans la perspective d'améliorer leur conscience environnementale. Ces stratégies de gestion oublient cependant souvent que les relations individuelles à la nature et à l'environnement immédiat ne dépendent pas de façon linéaire d'une communication explicite et de politiques publiques top-down (Buijs et Elands 2013). Ces relations sont en effet construites à l'intérieur d'interactions multiples, auxquelles participent aussi les acteurs directement concernés par les mesures de gestion proposées ; elles dépendent également de discours implicites sur la nature, véhiculés dans la gestion quotidienne de l'environnement urbain (Mugerauer 2010, Robbins 2007, Herda-Rapp et Goedecke 2005, Moscovici 2000).

Dans cette troisième partie, nous illustrons ces processus à travers deux articles, afin de contribuer à l'identification des mesures régulatrices ou incitatrices le plus à même d'engager les citoyens à des comportements pro-environnementaux et de celles qui au contraire les entraveraient.

3. a. Verdir la ville et ensuite ? Orientations similaires mais politiques publiques divergentes dans deux capitales européennes

Dans une première étude, nous détaillons les orientations politiques récentes de verdissement des villes et montrons la nécessaire prise en considération par les actions publiques environnementales des facteurs implicites aussi bien qu'explicites, tels que l'aménagement et la gestion des parcs, dont dépendent les attitudes des citoyens et leur acceptation de mesures mises en place. Dans une étude comparative entre Paris et Berlin, nous analysons deux modes différents de transposition de la planification environnementale générale dans la gestion des parcs urbains. Nous avons utilisé pour cela une stratégie de recherche multiple : analyse des stratégies des deux villes pour la biodiversité et le paysage, entretiens avec les gestionnaires des parcs, observations directes dans 13 parcs quant à leur aménagement et leur gestion, questionnaire auprès de citoyens à propos de leurs représentations de la nature.

Nos résultats montrent que les deux métropoles ont deux objectifs similaires : l'augmentation de la biodiversité urbaine et de la conscience environnementale des citoyens. Elles divergent cependant fortement dans leur mise en œuvre de ces objectifs, avec un niveau plus élevé de contrôle et de processus top-down à Paris qu'à Berlin. Parallèlement, les représentations des citoyens diffèrent entre les deux capitales, mais uniquement dans la vision de contrôle de la nature, qui est plus présente à Paris qu'à Berlin. Ces résultats appuient notre interprétation qu'à la place d'argument normatifs, il est nécessaire de donner aux citoyens plus d'espace avec la nature ainsi que de mettre en place des approches participatives dans la prise de décision environnementale afin de réussir la transition vers des paysages à la fois écologiquement viables et socialement durables.

3.b. Ancrer le ‘paradoxe du pigeon’ : médiation des interactions avec la biodiversité ordinaire par le contexte public

Dans un deuxième temps, nous traitons la question de la reconnexion humains-nature sous la perspective de l’expérience humaine de la biodiversité urbaine. Nous avons ainsi observé les interactions comportementales des citoyens avec les pigeons urbains. Nos résultats montrent que la plupart des personnes (moyenne : 85%) n’interagissent pas avec les pigeons. Ces interactions dépendent en outre du contexte et de l’âge : les enfants interagissent plus que les adultes et les personnes âgées, de même que les personnes dans les sites touristiques interagissent plus que celles dans les parcs urbains et les gares. Ces résultats suggèrent que ceux qui interagissent avec les pigeons sont probablement des touristes.

Nous interprétons les résultats en termes de normes sociales : la manière dont les espèces urbaines sont publiquement représentées et gérées pourrait constituer une pression normative sur les citoyens, ayant un effet potentiellement inhibiteur sur leurs interactions avec et favorisant une distance émotionnelle envers leur environnement direct.

4. Modélisation d’un système socio-écologique urbain : vers une coexistence des citoyens et des pigeons en ville

En guise de conclusion, nous examinons à travers le cas du pigeon urbain comment de nouveaux modèles de gouvernance pourraient aider à la résolution de conflits liés à la biodiversité urbaine, en considérant les perceptions de la nature et les processus socio-écologiques sous-jacents aux conflits. Nous avons en effet mis en évidence tout au long de la thèse dans quelle mesure différents acteurs humains et non-humains, ainsi que les discours parallèles issus de leurs interactions, façonnent le sens attribué à la biodiversité (ou à des espèces en particulier) et les attitudes humaines qui en découlent.

Nous nous appuyons ainsi sur les enseignements de la thèse pour proposer une analyse du conflit social au sujet de la présence des pigeons urbains dans les villes françaises. Nous proposons également une approche de mitigation qui se démarque des modèles classiques, axés uniquement sur la distribution et l'abondance des populations de pigeons. A partir d'une nouvelle vision des relations entre citoyens, autorités publiques et nature urbaine qui combine des données sociologiques et écologiques, nous construisons un modèle intégratif de gouvernance des pigeons en ville. Dans ce modèle, nous considérons la coexistence humains-pigeons non pas en termes de contrôle de la population de pigeons, mais plus généralement en termes de résilience, en tentant de réduire l'insatisfaction publique au sujet des pigeons. Pour cela, nous considérons les perceptions sociales des pigeons comme centrales dans le modèle, ainsi que les interrelations entre humains et pigeons, en incluant de multiples acteurs et leurs liens réciproques. Nous illustrons par ce biais l'importance d'une vision holistique dans la mise en œuvre des politiques publiques et de modèles de gouvernance de la nature.

Conclusion

Ces recherches proposent un nouveau modèle socio-écologique pour penser les milieux urbains : la biodiversité investit les habitats anthropiques en suivant ses propres dynamiques et règles. Ces caractéristiques écologiques et comportementales interagissent ensuite de façon dynamique avec des facteurs sociaux, politiques et économiques, à la fois en influençant et en étant influencées par l'environnement humain, pour produire des représentations de la nature. Interroger ces interactions permet une meilleure compréhension de 'où' et 'pourquoi' la biodiversité entre en contradiction avec des définitions humaines des paysages et des relations société-nature en jeu. Par conséquent, comprendre ces représentations sociales ainsi que l'écologie et le comportement des espèces permettrait de déterminer sur quels aspects écologiques en particulier il est recommandé d'agir, et de là quelles seraient les mesures appropriées au niveau socio-politique, dans le but d'augmenter l'acceptation sociale des espèces concernées. De même, reconnaître les multiples

niveaux (gestion de la nature, politiques publiques, contexte social) à travers lesquels les représentations de la nature et les relations société-environnement sont véhiculées, parfois même de façon contradictoire, permettrait d'identifier et de neutraliser d'autres motifs d'opposition.

A travers l'étude de cas des pigeons urbains, nous avons montré qu'un enjeu important dans la relation des humains à la nature et dans l'ordonnement de celle-ci est la définition de l'identité même des humains par rapport au vivant qui les entoure, ainsi que leurs droits sur la nature y étant intrinsèquement liés. Cet acte de définition est un processus en devenir, qui dépend des interactions multiples des humains avec la biodiversité. Néanmoins, tel qu'il a été démontré dans les recherches présentées ici, les acteurs publics, - décideurs mais aussi scientifiques, intellectuels etc. - pèsent sur les positions des membres de la société civile ; ils détiennent en ce sens une responsabilité particulière dans ce processus d'auto-définition de l'identité humaine par rapport au vivant. D'autre part, les résultats de nos recherches suggèrent de donner plus de place à tous ceux qui veulent participer au processus de redéfinition des relations des humains à la biodiversité vers des directions plus durables, en offrant à tous un espace de liberté dans l'interaction avec la nature.

Nous pensons que des modèles de gouvernance reposant sur un tel cadre d'analyse interdisciplinaire, peuvent être plus à même de reconnaître tous les acteurs comme co-habitants dans une métropole écologique hybride (Lestel 2010, Philo and Wolch 1998, Haraway 1991). Malgré son caractère normatif, inhérent au paradigme de conservation de façon générale (Sandbrook et al. 2013), une telle approche se démarque cependant d'impositions top-down par sa considération de tous les acteurs et de leur "agency" dans l'atteinte de ses objectifs.

L'application d'un tel cadre d'analyse pourrait être testée dans d'autres problématiques environnementales et conflits humains-biodiversité, dans des milieux non-urbains, davantage liés à l'utilisation des ressources et au développement économique. Ces mobiles sont en effet peut-être la partie visible d'une problématique beaucoup plus complexe impliquant des compréhensions

divergentes de la nature et des attributions du paysage ; par exemple quel est l'usage approprié d'un espace donné ; qui (humain ou non-humain) a des droits sur le territoire ; pourquoi ; qui dispose d'un pouvoir de décision etc. Clarifier en profondeur ces représentations, ainsi que les dynamiques multiples des systèmes qui les engendrent et les façonnent, pourrait contribuer à révéler, au-delà de compétitions matérielles avec la biodiversité et de prétentions vis-à-vis de la nature, d'autres problématiques de nature sociale, telles que des perceptions d'injustice sociale ou autres. Ceci permettrait ainsi d'identifier le problème de façon plus précise et peut-être de trouver des solutions de médiation plus durables.

REFERENCES

Badyaev A. V., Young R. L., Oh K.P., Addison C. 2008. Evolution on a local scale: developmental, functional, and genetic bases of divergence in bill form and associated changes in song structure between adjacent habitats. *Evolution* 62 :1951-1964.

Berkes F. and Folke C. (Eds.), 1998. *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge UK: Cambridge University Press.

Bonalume N., and Dickson D. 1999. \$3m deal launches major hunt for drugs in Brazil. *Nature* 400:302–322.

Brownlow A. 2000. A wolf in the garden: ideology and change in the Adirondack landscape. In : Chris Philo and Chris Wilbert ed. 2000. *Animal spaces, beastly places: new geographies of human-animal relations*, Routledge, London and New York. 143-160.

Buijs A.E., Elands B.H.M. 2013. Does expertise matter? An in-depth understanding of people's structure of thoughts on nature and its management implications. *Biological Conservation* 168: 184–191.

Buijs A.E., Arts B.J.M., Elands B.H.M., Lengkeek J. 2011. Beyond environmental frames: The social representation and cultural resonance of nature in conflicts over a Dutch woodland. *Geoforum* 42(3) : 329-341.

Burger J. and Gochfeld M. 2009. Exotic monk parakeets (*Myiopsitta monachus*) in New Jersey: nest site selection, rebuilding following removal, and their urban wildlife appeal. *Urban Ecosystems* 12: 185-196.

Campbell M. 2010. An Animal Geography of Avian Foraging Competition on the Sussex Coast of England. *Journal of Coastal Research* 261:44-52.

Claeys C. and Sirost O. 2010. Proliférantes natures. Introduction. *Etudes rurales* 1(185): 9-22.

Ditchkoff S.S., Saalfeld S.T., Gibson C.J. 2006. Animal behavior in urban ecosystems: Modifications due to human-induced stress. *Urban Ecosystems* 9: 5–12.

Douglas M. 1966. *Purity and danger*. London: Penguin.

-
- Duit A., Galaza V., Eckerberg K., Ebbesson J. 2010. Governance, complexity, and resilience. *Global Environmental Change* 20 : 363–368.
- Dunlap R. E. and Van Liere K. D. 1984. Commitment to the dominant social paradigm and concern for environmental quality. *Social Science Quarterly*. 65: 1013–1028.
- Dunn R.R., Gavin M.C., Sanchez M.C., Solomon J.N., 2006. The pigeon paradox: dependence of global conservation on urban nature. *Conservation Biology* 20: 1814-1816.
- Estes WA., Mannan RW. 2003. Feeding behavior of Cooper’s hawks at urban and rural nests in southeastern Arizona. *Condor* 105:107–116.
- Everding S.E. and Jones D.N. 2006. Communal roosting in a suburban population of Torresian crows (*Corvus orru*). *Landscape and Urban Planning* 74 :21-33.
- Figari H., and Skogen K. 2011. Social representations of the wolf. *Acta Sociologica* 54,317–332.
- Fine G.A. 1997. Naturework and the Taming of the Wild: The Problem of “Overpick” in the Culture of Mushroomers. *Social Problems* 44(1): 68-88.
- Folke C. 2006. Resilience: The emergence of a perspective for social–ecological systems analyses. *Global Environmental Change* 16: 253–267.
- Francis R.A., Chadwick M.A. 2012. What makes a species synurbic? *Applied Geography* 32:514-521
- Gandy M. 2006. Urban Nature and the Ecological Imaginary. In N. Heynen, M. Kaika and E. Swyngedouw (Eds.), *In the Nature of Cities Urban political ecology and the politics of urban metabolism*. London & New York : Routledge. 62-72.
- Gobster P.H., Nassauer J.I., Daniel T.C., Fry G. 2007. The shared landscape: what does aesthetics have to do with ecology? *Landscape Ecology* 22:959–972.
- Griffiths I.H and Poulter D.S. 2000. Feral Cats in the City. In : Chris Philo and Chris Wilbert ed. 2000. *Animal spaces, beastly places: new geographies of human-animal*. London and New York: Routledge. 59-72.
- Grimm N. B., Grove J.M., Pickett S.T.A., Redman C.L. 2000. Integrated approaches to long-term studies of urban ecological systems. *BioScience* 50:571-584.

Gustafsson K.M. 2013. Environmental discourses and biodiversity: the construction of a storyline in understanding and managing an environmental issue. *Journal of Integrative Environmental Sciences* 10(1):39-54.

Haraway D. 1991. *Simians, Cyborgs and Women: The Reinvention of Nature*. New York: Routledge

Herda-Rapp A. Goedeke T.L. eds. 2005. *Mad About Wildlife*. Boston: Brill.

Heynen N., Kaika M., Swyngedouw E. 2006. *Urban Political Ecology. Politicising the Production of Urban Natures*. In N. Heynen, M. Kaika and E. Swyngedouw (Eds.), *In the Nature of Cities Urban political ecology and the politics of urban metabolism*, pp 1-19. London & New York : Routledge

Holling C. S. editor. 1978. *Adaptive environmental assessment and mangement*. John Wiley & Sons, Chichester : United Kingdom.

Ibanez-Alamo J. D. and Soler M. 2010. Does urbanization affect selective pressures and life-history strategies in the common blackbird (*Turdus merula* L.)? *Biological Journal of the Linnean Society* 101: 759-766.

Jerolmack C. 2008. How Pigeons Became Rats: The Cultural-Spatial Logic of Problem Animals. *Social Problems* 55(2): 72-94.

Jerolmack C. 2007. Animal archeology: Domestic pigeons and the nature-culture dialectic. *Qualitative Sociology Review* III (1): 74-95.

Jones O. 2000. (Un)ethical geographies of human—non-human relations: encounters, collectives and spaces. In: Chris Philo and Chris Wilbert ed. 2000. *Animal spaces, beastly places: new geographies of human-animal relations*. London and New York: Routledge. 267-290.

Keulartz J., Van der Windt, H., Swart, J., 2004. Concepts of nature as communicative devices: the case of Dutch nature policy. *Environmental Values* 13: 81–99.

Kristan WB., Boarman WI., Crayon JJ. 2004. Diet composition of common ravens across the urban-wildland interface of the West Mojave Desert. *Wildlife Society Bulletin* 32:244–253.

Latour B. 1993. *We Have Never Been Modern*. Cambridge: Harvard University Press.

Lestel D. 2010 : *L'Animal est l'Avenir de l'Homme*. Paris : Fayard.

-
- Levey D. J., Londono G. A., Ungvari-Martin J., Hiersoux M. R., Jankowski J. E., Poulsen J.R., et al. 2009. Urban mockingbirds quickly learn to identify individual humans. *Proceedings of the National Academy of Sciences of the United States of America* 106: 8959-8962.
- Maffi L. and Woodley E. 2010. *Biocultural Diversity*. London : Earthscan.
- Maris V. and Béchet A. 2010. From adaptive management to adjustive management: a pragmatic account of biodiversity values. *Conservation biology* 24(4): 966-73.
- Miller J.R. 2005. Biodiversity conservation and the extinction of experience. *Trends in Ecology and Evolution* 20: 430-434.
- Minteer BA. and Collins JP. 2005. Why we need an "ecological ethics". *Frontiers in Ecology and Environment* 3(6): 332-337.
- Moscovici S. 2000. *Social Representations. Explorations in Social Psychology*. Polity Press, Cambridge.
- Mugerauer R. 2010. Toward a theory of integrated urban ecology: complementing Pickett et al. *Ecology and Society* 15(4): 31.
- Ostrom E. 2009. A General Framework for Analyzing Sustainability of Social-Ecological Systems. *Science* 325: 419-422.
- Partecke J. and Gwinner E. 2007. Increased sedentariness in European Blackbirds following urbanization: a consequence of local adaptation? *Ecology* 88: 882-890.
- Philo C. and Wilbert C. ed. 2000. *Animal spaces, beastly places: new geographies of human-animal relations*. London and New York: Routledge. 1-36.
- Philo C. and Wolch J. 1998. Through the Geographical Looking Glass: Space, Place, and Society-Animal Relations. *Society and Animals* 6(2) :103-118
- Prange S., Gehrt S.D., Wiggers EP. 2004. Influences of anthropogenic resources on raccoon (*Procyon lotor*) movements and spatial distribution. *Journal of Mammalogy* 85:483–490.
- Rejmànek M. 2000. Invasive plants: approaches and predictions. *Austral Ecology* 25: 497–506.
- Robbins CT. 1993. *Wildlife feeding and nutrition*. San Diego, California: Academic Press.

- Robbins P. 2007. *Lawn People. How Grasses, Weeds, and Chemicals Made Us Who We Are*. Temple University Press: Philadelphia.
- Rosenzweig M.L. 2003. Reconciliation Ecology and the Future of Species Diversity. *Oryx* 37(2): 194–205.
- Sandbrook C., Adams W.M., Büscher B., Vira B. 2013. Social Research and Biodiversity Conservation. *Conservation Biology* 27(6): 1487-1490.
- Skandrani Z., Lepetz S., Prévot-Julliard A-C. 2014. Nuisance Species: beyond the ecological perspective. *Ecological Processes* 3(3): 1-12.
- Smith N. 2006. Foreword. In N Heynen, M Kaika and E Swyngedouw (Eds.), *In the Nature of Cities Urban political ecology and the politics of urban metabolism*. London & New York : Routledge.
- Stephen S., Ditchkoff S., Saalfeld T., Gibson C.J. 2006. Animal behavior in urban ecosystems: Modifications due to human-induced stress. *Urban Ecosystems* 9: 5–12.
- Swyngedouw E. 1999. Modernity and Hybridity: Nature, Regeneracionismo, and the Production of the Spanish Waterscape, 1890–1930”, *Annals of the Association of American Geographers* 89(3): 443–465.
- Wang Y. P., Chen S. H., Blair R. B., Jiang P.P., Ding P. 2009. Nest composition adjustments by Chinese Bulbuls *Pycnonotus sinensis* in an urbanized landscape of Hangzhou (E China). *Acta Ornithologica* 44: 185-192.
- Wang Y. P., Chen S. H., Jiang P.P., Ding P. 2008. Black-billed Magpies (*Pica pica*) adjust nest characteristics to adapt to urbanization in Hangzhou, China. *Canadian Journal of Zoology* 86:676-684.
- White L. 1967. The Historical Roots of Our Ecologic Crisis. *Jr. Science, New Series* 155(3767): 1203-1207.
- Wolch J., Brownlow A., Lassiter U. 2000. Constructing the animal worlds of inner-city Los Angeles. In : Chris Philo and Chris Wilbert ed. 2000. *Animal spaces, beastly places: new geographies of human-animal relations*. London and New York: Routledge. 73-98.

Yeh P.J. 2004. Rapid evolution of a sexually selected trait following population establishment in a novel habitat. *Evolution* 58: 166-174.

Young O.R., Berkhout F., Gallopin G.C., Janssen M.A., Ostrom E., Van der Leeuw S. 2006. The globalization of socio-ecological systems: An agenda for scientific research. *Global Environmental Change* 16(3): 304-316.

APPENDICES

APPENDIX 1. Observation protocol for the study in Chapter 3., Manuscript 1: “Anchoring the ‘pigeon paradox’: how public context mediates interactions with ordinary biodiversity”

Behavior type	Behavior	Number of observations	Total
neutral	Passing by pigeons		
	Total indifference		
positive	Showing an interest in pigeons		
	Observing pigeons		
	Walking quietly towards them		
	Feeding pigeons		
negative	Being frightened by pigeons		
	Making defensive gestures		
	Throwing projectiles		
Others non neutral	Walking next to pigeons and trying to avoid contact		
	Running towards pigeons with gesticulations		

APPENDIX 2. Questionnaires and observation protocol (in original language) for the study in Chapter 3., Manuscript 2: “Greening the city, and further? Similar orientations but contrasted local policies in two European capitals”

2.1. Semi-directive interview of urban park managers

Sur quels textes légaux et administratifs reposent vos pratiques environnementales ?

Avez-vous un inventaire des plantes du jardin ?

Faites-vous usage de phytosanitaires ? Fertilisants ? Pesticides ?

Quelles strates sont concernées : arborée, arbustive, herbacée, florale, aquatique, minérale ?

Comment gérez-vous la flore spontanée ?

Pour les strates herbacées, y a-t-il une tolérance des pâquerettes, plantain et autre ?

Quelle est la fréquence de la tonte ou de la fauche ?

Pratiquez-vous l'égailage des arbres ? A quelle fréquence ?

Pratiquez-vous le désherbage des arbres ?

Ce désherbage est-il chimique ?

Pratiquez-vous le désherbage de la strate minérale ?

Ce désherbage est-il chimique ?

La réduction des espaces minéralisés est-elle prévue dans le plan de gestion ?

Dans la strate aquatique, y a-t-il un nettoyage de l'eau et un curage avec vidange ?

Ce nettoyage est-il chimique ?

Dans la strate aquatique, y a-t-il une gestion de la faune et de la flore ?

Retirez-vous des espèces exotiques et des poissons ?

Intervenez-vous sur la faune dans le parc ?

Pratiquez-vous la dératisation ou la destruction de nids ?

Selon quels critères s'effectue le choix de la palette végétale ?

La priorité est-elle sur les plantes et fleurs les plus rustiques (qui exigent peu de soins pour prospérer), les plus adaptés au site ? Sur des espèces communes ? Sur une flore moins coûteuse en eau ?

Quel est le type de sols utilisés ? Celui déjà en place ?

Quelle est la fréquence arrosage ou d'irrigation ?

Est-elle manuelle ou automatique ?

Quelles strates sont irriguées ?

D'où provient l'eau d'arrosage ?

Y a-t-il un suivi des quantités d'eau mensuelles utilisées ?

Y a-t-il un suivi de la consommation énergétique

Y a-t-il un éclairage nocturne

Y a-t-il des mesures concrètes de réduction de consommation d'énergie ?

Avez-vous des équipements producteurs d'énergie renouvelable ?

Pratiquez-vous la mise en place de nichoirs ou de ruches ?

Y a-t-il un suivi de la faune et flore ? Sous quelle forme ?

Que faites-vous des déchets ? Pratiquez-vous le compostage ?

Mettez-vous en place des événements de sensibilisation, des activités pédagogiques à caractère environnemental ?

Avez-vous mis en place une forme de participation citoyenne dans le parc ? Laquelle ?

Heure:

[illegible]

2.3. Questionnaire on city dwellers' nature representations

- Pour chaque question, cochez s'il vous plaît la réponse qui vous convient le mieux.
- Ne cochez **qu'une seule** réponse par question.

1/ Quel parc fréquentez-vous le plus souvent ?

2/ Qu'est-ce qui représente pour vous la nature en ville?

- ☐ Les allées arborées
- ☐ Les friches
- ☐ Tous les animaux et la végétation en ville
- ☐ Les arbres en fleurs au printemps
- ☐ Ne sais pas

3/ Comment qualifieriez-vous la végétation spontanée et les animaux (oiseaux, insectes, animaux non domestiques) en ville :

- ☐ Peuvent représenter un enjeu sanitaire
- ☐ Attractifs
- ☐ Quelconques
- ☐ Nécessaires
- ☐ Ne sais pas

4/ Quel sentiment vous procure la présence de la végétation spontanée et des animaux (oiseaux, insectes, animaux non domestiques) en ville?

- ☐ Un sentiment de continuité écologique
- ☐ Un sentiment d'inconfort
- ☐ Un sentiment de bien-être
- ☐ Un sentiment d'indifférence
- ☐ Ne sais pas

5/ Quelle est selon vous la valeur de la nature en ville?

- ☐ Elle reflète l'art et la création horticole
- ☐ Elle est récréative
- ☐ Elle apporte un sentiment de paix
- ☐ Elle a une valeur en soi
- ☐ Ne sais pas

6/ Pour vous, les arbres:

- ☐ Sont source d'oxygène et d'ombre en été
- ☐ Ont un effet calmant
- ☐ Sont source d'allergies
- ☐ Sont Favorables aux oiseaux et aux pollinisateurs
- ☐ Ne sais pas

7/ Quel type d'espaces verts vous plaît le plus ?

- ☐ Parcs floraux et botaniques
- ☐ Parcs historiques
- ☐ La forêt
- ☐ Les parcs avec une gestion écologique
- ☐ Ne sais pas

8/ Quels aspects du paysage préférez-vous?

- ☐ Les pelouses bien entretenues
- ☐ Les étangs et les mares
- ☐ Les parterres de fleurs
- ☐ L'herbe haute et les fleurs sauvages
- ☐ Ne sais pas

9/ Avez-vous des préférences pour certains animaux en ville?

- ☐ Les abeilles
- ☐ Les animaux de compagnie
- ☐ Les papillons
- ☐ Tous sans distinction
- ☐ Ne sais pas

10/ Quel objectif de gestion de la nature en ville vous semble le plus adéquat?

- ☐ Avoir des espaces soignés
- ☐ Avoir des espaces sûrs
- ☐ Encourager la biodiversité
- ☐ Laisser libre cours aux éléments naturels
- ☐ Ne sais pas

11/ Parmi les affirmations suivantes, laquelle décrit le mieux votre dérangement par les plantes et les animaux urbains ?

- ☐ Je suis dérangé par le grand nombre de pigeons
- ☐ Je suis dérangé par les mauvaises herbes qui nuisent à la beauté de la ville
- ☐ Je n'en suis jamais dérangé
- ☐ Même si je peux en être dérangé, le fonctionnement naturel est prioritaire
- ☐ Ne sais pas

12/ S'il devait y avoir des changements, lequel préférez-vous?

- ☐ Un meilleur contrôle des espèces invasives
- ☐ Re-végétalisation et re-animalisation de la ville
- ☐ Une plus grande valorisation ornementale de la nature
- ☐ Une plus grande valorisation de la nature spontanée
- ☐ Ne sais pas

12/ Laquelle de ces pratiques vous décrit le mieux?

- ☐ Je consomme bio
- ☐ J'aime entretenir des fenêtres ou balcons fleuris
- ☐ Dans les parcs j'aime m'asseoir sur les bancs ou les chaises
- ☐ Dans les parcs j'aime m'asseoir sur l'herbe
- ☐ Aucune

13/ Avez-vous un contact fréquent avec la nature en ville?

- ☐ Oui
- ☐ Non
- ☐ Ne sais pas

14/ Êtes-vous vous-mêmes engagé dans des actions de promotion de la nature en ville?

- ☐ Oui
- ☐ Non

15/ Dans le cas où vous avez des plantes, utilisez-vous de produits phytosanitaires?

- ☐ Oui
- ☐ Non
- ☐ Je n'en ai pas

16/ Informations générales :

Âge:

Genre:

Profession:

Où Avez-vous passé l'essentiel de votre enfance ?

- ☐ Grande agglomération
- ☐ Ville moyenne
- ☐ Petite ville
- ☐ village

2.4. Pre-coded questionnaire on city dwellers' nature representations

4 types of nature relations :

Objectification (commodité ou esthétisme) = 1

Mastership = 2

Stewardship = 3

Oneness (participation) = 4

Relation à travers 3 types d'attention: Cognitive (perceptions), affective (préférences) et comportementales (pratiques)

Perceptions:

- Qu'est-ce qui représente pour vous la nature en ville?

=> Les arbres en fleurs au printemps (1), Les allées arborées (2), Les friches (3), Tous les animaux et la végétation en ville (4), Ne sais pas

- Comment qualifieriez-vous la végétation spontanée et les animaux (non domestiques, oiseaux, insectes) en ville :

=> Quelconques (1), Peuvent représenter un enjeu sanitaire (2), Nécessaires (3), Attractifs (4), Ne sais pas

- Quel sentiment vous procure la présence de la végétation spontanée et des animaux (non domestiques, oiseaux, insectes) en ville?

=> Un sentiment d'indifférence (1), Un sentiment d'inconfort (2), Un sentiment de continuité écologique (3), Un sentiment de bien-être (4), Ne sais pas

- Quel est selon vous la valeur ou le bénéfice de la nature en ville?

=> Récréatif (1), Représenter l'art et la création horticole (2), Valeur en soi (3), Sentiment de paix (4), Ne sais pas

- Les arbres sont:

=> Source d'oxygène et d'ombre en été (1), Source d'allergies (2), Favorable aux oiseaux et aux pollinisateurs (3), Ont un effet calmant (4)

Préférences:

- Quel type d'espaces verts vous plaît le plus ?

=> Parcs floraux et botaniques (1), Parcs historiques (2), Les parcs avec une gestion écologique (3), la forêt (4), Ne sais pas

- Quels aspects du paysage préférez-vous?

=> Les parterres de fleurs (1), Les pelouses bien entretenues (2), Les étangs et les mares (3), L'herbe longue et les fleurs sauvages (4), Ne sais pas

- Avez-vous des préférences pour certains animaux en ville?

=> Les papillons (1), Les animaux domestiques de compagnie (2), Les abeilles (3), Tous sans distinction (4), Ne sais pas

- Quel type de gestion de la nature en ville vous semble le plus adéquat?

=> Une gestion soignée (1), Une gestion dont la priorité est la sécurité (2), une gestion propice à la biodiversité (3), Une gestion libre (4), Ne sais pas

- Êtes-vous parfois dérangé par la faune ou la flore urbaine?

Je suis dérangé par les mauvaises herbes qui nuisent à la beauté de la ville (1), Je suis dérangé par le grand nombre de pigeons (2), Même si je peux en être dérangé, le fonctionnement de l'écosystème est prioritaire (3), Je n'en suis pas dérangé (4), Ne sais pas

- S'il devait y avoir des changements dans la nature en ville, quels devraient-ils être?

=> Une plus grande valorisation ornementale de la nature (1), Mieux contenir les espèces invasives (2), Une plus grande valorisation de la nature ordinaire (3), Re-végétalisation et re-animalisation de la ville (4), Ne sais pas

Pratiques

- Laquelle de ces pratiques vous décrit?

=> J'aime entretenir des fenêtres ou balcons fleuris (1), Dans les parcs j'aime m'asseoir sur les bancs ou les chaises (2), Je consomme bio (3), Dans les parcs j'aime m'asseoir sur l'herbe (4), Aucune