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# Large carnivores and zoos as catalysts for engaging the public in the protection of biodiversity

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## Abstract

Addressing the biodiversity crisis requires renewed collaborative approaches. Large carnivores are ambassador species, and as such they can aid the protection of a wide range of species, including evolutionarily distinct and threatened ones, while being popular for conservation marketing. However, conflicts between carnivores and people present a considerable challenge to biodiversity conservation. Our cross disciplinary essay brings together original research to discuss key issues in the conservation of large carnivores as keystone species for biodiversity rich, healthy ecosystems. Our findings suggest the need to promote coexistence through challenging 'wilderness' myths; to consider coexistence/conflict as a continuum; to include

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varied interest groups in decision making; to address fear through positive mediated experiences, and to explore further partnerships with zoos. As wide-reaching institutions visited by over 700 million people/year worldwide, zoos combine knowledge, emotion and social context creating ideal conditions for the development of care towards nature, pro-environmental behaviors and long-term connections between visitors and carnivores. Based on current research, we provide evidence that large carnivores and zoos are both powerful catalysts for public engagement with biodiversity conservation, recognizing barriers and suggesting future ways to collaborate to address biodiversity loss.

**Keywords**
conservation biology; human-wildlife conflict; large carnivores; ambassador species; zoos; biodiversity conservation

## Introduction

Awareness of biodiversity values and sustainable use are key concerns in mainstreaming biodiversity across society and halting its loss (Aichi Target 1 https://www.cbd.int/sp/targets/rationale/target-1/default.shtml). Research indicates that biodiversity is not salient to people (Consorte-McCrea et al. 2017a; Legagneux et al. 2018) yet evidence shows that developing strong connections with charismatic species, large carnivores (e.g. bears, big cats, wolves, elephant seals) in particular, could benefit biodiversity conservation as large carnivores are "ambassador species" – species whose range overlap greatly with that of EDGE – Evolutionarily Distinct and Globally Endangered – species, while being popular amongst the public (Macdonald et al. 2017). Nevertheless, conflict and fear may pervade the relationship between people and carnivores, especially in rural areas.

Research also indicates that social context and experience together with pro-environmental messaging can promote the development of a connection with nature and pro-environmental behaviors (Clayton et al. 2017a), reduce fear and address conflict. Such conditions are often provided by zoos, where large carnivores are a familiar feature.

This paper offers a synthesis of contributions presented at the symposium "Large carnivores and zoos as catalysts for biodiversity conservation: how do we engage the public in the protection of biodiversity?" at the European Congress for Conservation Biology (ECCB), Finland 2018. Bringing together natural and social sciences, as well as psychology and education, it provides a rich multifaceted approach to the conservation of biodiversity by exploring the connections between people, large carnivores and zoos. We review research that addresses key challenges to the acceptance of large carnivores and examine the role of zoos in promoting connection to nature, exploring solutions, and suggesting future ways in which programs for the conservation of these charismatic species and zoos can collaborate to achieve public commitment towards biodiversity conservation.

## The return of a biodiversity keystone

Large carnivores are considered catalysts for the conservation of biodiversity due to their charisma, their role in regulating ecosystem dynamics and their rich cultural and historical heritage (Linnell et al. 2005; Macdonald et al. 2017). Research suggests that there are many links between wild predators and enhanced biodiversity (see Sergio et al. 2006 for a review; Lennox et al. 2018; O'Bryan et al. 2018). As humans removed large carnivores as apex predators in ecosystems worldwide, classic trophic level cascades were transformed into systems dominated by smaller carnivores and herbivores, putting pressure on plant species composition and abundance, and resulting in loss of biodiversity (McShea 2005; Steneck 2005; Lennox et al. 2018). Despite their key stone role in biodiversity, large carnivores are often not welcomed by people; their presence may cause tensions and be at the root of historic human-wildlife conflict.

Changes in land use combined with widespread bounties on large carnivores since the middle ages, culminated in their steep decline across many countries (Trouwborst 2010). However, a combination of factors beginning in the last decades of the 20$^{th}$ century have resulted in a transformed scenario: although the human population has never been higher, over 50% is now concentrated in urban areas (Hinds and Sparks 2008). As a result forests have regenerated, providing the necessary resources for the return of many species of herbivores, which together with protective legislation enabled the return of wild carnivores (Trouwborst 2010). Nevertheless, an increase in large carnivores' populations may affect public attitudes towards them in the future (Eriksson et al. 2015).

Interactions between people and carnivores are interpreted differently by different people. These interactions can give rise to conflicts not only between people and large carnivores, but also between social groups. The first type of conflict often reflects concerns related to fears for own safety or that of others, or fear of loss of other favored species (Knight 2001; Frank et al. 2015; Carter and Linnell 2016), but also concerns associated to material interests related to game, farming or property. The second type of conflict rather reflects socio-economic tensions between interest groups or other social groups formed by an urban-rural divide (Skogen et al. 2008). Such concerns and tensions play into people's negative attitudes towards the presence of wild carnivores and lack of support towards conservation (Bath et al. 2008; Torkar et al. 2010; Johansson et al. 2012a). High levels of knowledge about carnivores, on the other hand, have been associated with positive attitudes towards them, particularly when knowledge comes from trusted sources (Kellert et al. 1996; Roskaft et al. 2007; Glikman et al. 2012).

Due to continuous changes in land use, areas of healthy habitat and protected areas are usually small and fragmented and cannot sustain many wild carnivores. Therefore, local landowners and the general public become necessary partners in the survival of wild populations. Even more than a need for a pristine habitat, the success of conservation and recovery of carnivores, hence biodiversity, depends on the involvement of interest groups in the process, and public support (Amit and Jacobson 2018; Bombieri

et al. 2018). While we need to engage people in conservation, coexistence presents new challenges. Although in areas where wild carnivores have persisted people have developed strategies to coexist with them, in areas where they have returned after a long absence such practices may have been lost and conflicts may ensue (Linnell et al. 2005; Musiani et al. 2009; Trouwborst 2010).

## Taking steps towards coexistence with large carnivores

One way of promoting coexistence requires rethinking the separation between human areas and wildlife areas. Large carnivores show capabilities to adapt to different human-dominated ecosystems across the world (Woodroffe et al 2005; Ahmadi et al. 2014; Blackburn et al. 2016), which supports the idea that separation is not a necessary condition for large carnivore conservation (López-Bao et al. 2017). Evidence supporting the idea of coexistence with large carnivores can be found worldwide (e.g., Zimmermann et al. 2010; Morell 2013; Chapron et al. 2014; Alexander et al. 2016). The challenge remains whether human societies can accept and adapt to non-predator-free landscapes (Carter and Linnell 2016; López-Bao et al. 2017), and how to engage the public support of such a group of contentious species.

Addressing the challenge of human-large carnivore coexistence requires multiple steps at the individual, societal and institutional levels. For example: i) removing the symbolic value of large carnivores: nowadays large carnivores are symbolically linked to wilderness and remoteness, and the notion that these elements are important for their conservation has prevailed in many contexts, shaping the range of these species (López-Bao et al. 2017); ii) promoting adaptation of human behavior to reduce risks and costs of coexisting with large carnivores (Carter and Linnell 2016): appropriate livestock husbandry practices (e.g., protecting free-ranging livestock at night, Pimenta et al. 2017) and the implementation of interventions to decrease the likelihood of carnivore attacks (van Eeden et al. 2018) may contribute to make farming activities compatible with large carnivore presence; and iii) recognizing not only costs, but also the benefits of large carnivores (Bruskotter and Wilson 2014; López-Bao et al. 2017; O'Bryan et al. 2018).

## Living with large carnivores: looking at the glass half-full

It is useful to look at both negative and positive aspects of human-carnivores interactions as part of a continuum. Conflict or coexistence are not just opposite terminologies used to define human-wildlife interactions; they also represent the lenses we choose to use when addressing any interaction between people and wildlife. Conceptualizing human-wildlife interactions as wildlife threatening human interests and livelihood may limit the understanding of the deep-rooted reasons behind conflicts, which are often better defined as human-human conflicts (Young et al. 2010; Bhatia et al. 2016; Madden and McQuinn 2017). Moreover, by focusing on conflicts all the

neutral to positive interactions between humans and wildlife can be overlooked, hiding the fact that often people and wildlife do coexist in a shared landscape.

To better include coexistence in human-wildlife interaction discourses, Frank (2016) introduced the conflict-to-coexistence continuum framework. This continuum addresses the entire range from negative to positive attitudes and/or behaviors toward wildlife, which encompasses the different degrees of conflict and coexistence that typify human-wildlife interactions. The type of interaction is context-laden and varies depending on an array of factors, from the costs and benefits of sharing the landscapes with wildlife to social and cultural context, including human-human interactions (Morzillo et al. 2014; Frank 2016; Yurco et al. 2017). Conflict-to-coexistence dispositions toward wildlife are dynamic and can change over time, across geographical scales, and in intensity, shifting along the continuum as interactions with wildlife evolve (Frank and Glikman 2019). Ultimately, human-wildlife interactions are not about the presence or absence of conflict or coexistence; they are about how the relationship shifts along the conflict-to-coexistence continuum over space and time and across species. The challenge is how to move the discourse toward more inclusive and positive relations with wildlife.

As the resolution of human-large carnivore conflict is often delegated to wildlife managers, the engagement of local people in decision making can be a rare occurrence. Traditional tools often fail to drive diverse interest groups to consensus and the resolution of conflicts. Methods such as the applied human dimensions facilitated workshop approach (AHDFWA) focus on building strong relationships and teams to solve current people-wildlife conflicts, achieving success in addressing challenges of living with wild carnivores across the globe (Hazzah et al. 2017; Schulz et al. 2017). According to Alistair Bath, "it is important to take the time to effectively move beyond *engagement* to a *committed relationship* of trust to achieve consensus and conservation successes."

Considering that the occurrence of predator attacks on humans is rare, tolerance of risks is affected by norms, culture, spiritual beliefs, cognitive and emotional factors, including risk perception (Carter and Linnell 2016; Bombieri et al. 2018; Struebig et al. 2018). Therefore, one of the priorities in large carnivore conservation must be to break down barriers by finding strategies to address and manage people's fears and perceptions of risk. The following sections explore these points in greater detail.

## Addressing people's fear in large carnivore conservation: a case study from Sweden

Although most people in Sweden hold a positive attitude towards biodiversity conservation (Lindström et al. 2006) some may see the presence of large carnivores as a positive and rewarding experience, while others may respond with feelings of fear for themselves or their children and pets. These emotions must be taken into consideration in biodiversity conservation as they have implications for people's quality of life (Flykt et al. 2013), and are associated with attitudes towards wildlife policy and acceptance of management measures (Johansson et al. 2012a; Jacobs et al. 2014; Frank et al. 2015)

The diverse feelings evoked towards carnivores could partly be explained by people's different appraisal of what an encounter with the species would be like. Individu-

als who think about such an encounter as a potential danger and think they would be unable to predict the animal's behavior in the situation and consider their own reaction as uncontrollable, express stronger fear (Johansson et al. 2012a, 2012b; 2016a).

In the case of brown bears, the literature proposes four major groups of fear interventions: information and education, exposure to animal and habitat, collaboration and participation, and financial incentives (Johansson et al. 2016a). But the effects of these interventions on people's feelings of fear are rarely evaluated. From a psychological point of view the intervention would only contribute to reduced feelings of fear if an encounter with the species is re-appraised in relation to coping strategies. Two such interventions were developed in collaboration with researchers in wildlife ecology, large carnivore information centers and wildlife parks in Sweden: information meetings, and guided walks close to radio-collared brown bears (Johansson et al. 2016b, 2017). Results suggested that both interventions can decrease fear of brown bears if there is an opportunity to re-appraise the potential consequences of a brown bear encounter. This suggests that both the design of information content, and the social and environmental contexts are important. Key aspects were a) a positive social interaction with a presenter or guide with personal experience of brown bear encounters who could serve as a role model for appropriate behavior in brown bear areas, and b) the opportunity to gain an understanding of how brown bears use the terrain. Therefore, guided walks in brown bear areas may be a more efficient approach than information meetings indoors. Similar experiences could be promoted in wildlife parks and zoos (Johansson et al. 2019).

To what extent the reduced feelings of fear also influence people's attitudes towards brown bears remains to be seen, but they could strengthen a positive emotional connection with nature. In this next section we will take a closer look at the role of emotional connection and an understanding of care in the context of biodiversity.

## Building a committed relationship with biodiversity through concern and care

Research points to lack of interest in nature and reduced commitment to biodiversity conservation as being linked to cognitive elements such as misconceptions and negative messages about wildlife in formative years (Velsor and Nilon 2006; Consorte-McCrea et al. 2017b) and to declining opportunities to engage with nature from childhood. This phenomenon has been described as the *extinction of experience* (Pyle 2002). While the *biophilia hypothesis* (Kellert and Wilson 1993) proposes we evolved an intrinsic emotional bond with other living organisms, there are suggestions that "learning, culture and experience" are necessary to strengthen this fragile bond (Kellert 2002; Hinds and Sparks 2008: 110).

People's progressive amnesia of what the landscapes were like before large carnivores disappeared may result in acceptance of natural spaces devoid of carnivore species (see Kahn and Kellert 2002; Steneck 2005). However, beyond their role in ecosystem dynamics, wild carnivores can help us connect with nature, "put some of the wild back into our lives", and help us glimpse into the dynamics and interconnections that are at the essence of biodiversity (Linnell et al. 2005: 399; Boitani and Linnell 2015). In-

terestingly, research suggests that affective experiences provide important entry points for connection with large carnivores (Millar and Millar 1996; Kellert 2002; Roskaft et al. 2007). In rural Norway, positive attitudes towards wolves were associated with expectations of seeing them in the wild (and with the excitement derived from these encounters) (Roskaft et al. 2007).

Connection with nature can also relate to a sense of responsibility and stewardship towards it and concerns for future generations (Novacek 2008). Findings from focus groups carried out in the UK are in line with this argument (Consorte-McCrea et al. 2017a). Participants held strong views about collective responsibility:

"I think for people with children, they've got to look at the future of their children as living as part of the planet. That if we introduce these [carnivores], it will benefit their children because there will be more forests and natural environments for our animals and show that as a positive thing for the adults of children [sic], that's what they're going to grow up with. It's not going to be a major threat to your child, it's going to be a positive step for them in the future."

A moral purpose is necessary to motivate society to meet challenges such as the ones presented by biodiversity loss, shifting the focus from individual moral choices to "our collective ability to recognize, reflect upon, and reasonably address the value questions we face." (Clayton and Myers 2009: 53). The contribution of zoos to addressing these challenges is discussed in the next section.

## The role of zoos in developing the relationship between people and biodiversity

Zoos have been considered as catalysts for conservation, recognized as partners by the scientific community for their contributions in skills and expertise that span animal care, husbandry, public engagement, education and research (Zimmermann et al. 2007; Moss et al. 2015; Gilbert and Soorae 2017). A growing commitment to biodiversity conservation has been reflected by zoos and aquariums directives, including WAZA's (The World Association of Zoos and Aquariums) pledge to contribute to meet the Aichi Biodiversity targets (Moss et al. 2015).

Zoos and aquariums are some of the most-visited institutions, with around 700 million visits globally each year. Justifications for the continued existence of zoos have evolved since their inception in the late 18$^{th}$ and early 19$^{th}$ centuries, and nearly all now position themselves as organizations focused on the conservation of biodiversity. Public education of visitors is seen as a central role in achieving this mission. Until relatively recently though, very little was known about the impacts of zoo-based education on visitors.

Moss et al. (2015, 2017) surveyed over 10,000 visitors to zoos and aquariums worldwide. Their findings indicate that:

a) People tend to end their visit with a significantly greater understanding of what biodiversity is, and the ways that they personally can help protect it.

b) The links between these two knowledge strands were, however, found to be weaker than predicted, which leads us to question the significance of the role of knowledge in catalyzing human behavior change.
c) The wider implication of this research is that zoos and aquariums are helping to achieve global biodiversity targets; namely, UN Aichi Biodiversity Target 1.

A follow-up survey of 161 participants revealed a further possible 'sleeper effect' resulting in the long-term increase in knowledge of pro-biodiversity actions (Jensen et al. 2017). It may be that a visit to the zoo awakens an interest in information about actions that may help biodiversity, in people's everyday lives. Therefore, the educational role of zoos should be considered as a more influential contributor to biodiversity conservation than has previously been accepted.

However, the positive effect of a zoo visit may be influenced by the way the public perceive care for animal welfare (Grajal et al. 2016; Consorte-McCrea et al. 2017a). Research also highlights the potential for unintended consequences, whereby the availability of endangered species in zoos could spark reduced interest in their conservation in the wild (Consorte-McCrea et al. 2017a). The implications of such beliefs amongst zoo visitors require further investigation.

Support for the conservation of large carnivores and for biodiversity is more likely when people have an emotional appreciation for diverse species, not just understanding. Both aspects are likely to be enhanced by direct experiences, such as visits to zoos and aquariums that provide an increasingly important opportunity for contact with other species.

## Developing connection and care for nature in the zoo

The direct experiences of nonhuman animals provided by zoos have two psychologically important characteristics: they are vivid and emotionally rich, and they are typically shared with others. Vivid, emotional experiences attract more attention and they are better remembered, contributing to understanding. Social interactions surrounding zoo animals are opportunities to create and communicate shared emotional experiences and values. It is important to recognize that experiences of nature are a process, socially facilitated (or discouraged), mediated, and interpreted (Clayton et al. 2017b). Thus, the impact of a zoo visit is determined not only by the visitor's exposure to animals but by a social context that directs attention toward particular features, encourages conversation among the visitors, and endows the animals with socially-sanctioned value.

Research in several Parisian zoos examined the experience of a zoo visit, to investigate the zoo's ability to promote conservation concerns and to explore the complexity of such a visit, beyond the presumed connection among captive wild animals, visitors, and wildlife conservation issues (Figure 1). One study compared attitudes toward biodiversity among visitors to urban zoos with those of visitors to other urban parks, finding that zoo visitors reported higher concern about biodiversity, and that the frequency of zoo visits was correlated with concern (Colléony 2016). A separate study found

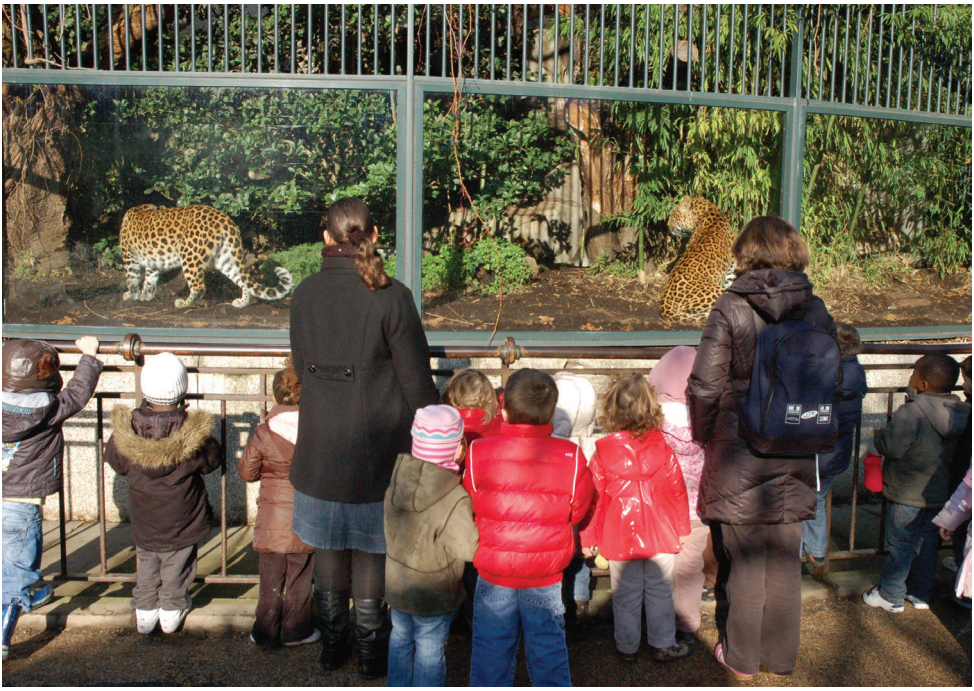


**Figure 1.** Visitors contemplating large carnivores, Menagerie du Jardin des Plantes, Paris (photo by M. SaintJalme).

that people also seemed to experience the zoo visit as an experience of nature: visitors express the feeling of "being away" when visiting the zoo, and they became more receptive to other components of biodiversity (e.g. common urban birds) in addition to the presented wildlife (Colléony et al. 2017). In a third study (Clayton et al. 2017b), zoo visitors scored higher on biodiversity concern and knowledge at the end of the visit than at the start, consistent with the findings reported by Moss et al. (2015).

Although people are attracted to the zoo to see wild animals, they are more likely to report visiting a zoo for social reasons than to learn about animals, and that their satisfaction with the visit is based in part on its success as a leisure experience. Visitors declared having felt more positive than negative emotions when exiting the zoo. However, the entertainment and educational aspects of the zoo can be mutually supporting: positive emotions were more reported by visitors who said they had learnt more (Clayton et al. 2017b).

There is much room for improvement in the ability of zoos to promote conservation. A single visit does not always increase visitors' concern for wildlife conservation. In a telling example, participating in a zoo-based animal adoption program was found to be motivated more by animal charisma than by concern about endangered species (Colléony et al. 2016). This finding could be interpreted in two ways: first, zoos may need to do more to articulate the value of endangered species, especially when solicit-

ing donations; in addition, zoos may be able to capitalize on animal charisma to encourage more support for their conservation efforts.

Zoos are important places for conservation, but their impact may be primarily indirect: zoos are places where complex and shared experiences of nature can be promoted, to increase the sense of being connected to the natural world. It is important for them to demonstrate respect, and to encourage empathy and connection toward the nature presented at their sites.

## Discussion and conclusions

Current trends indicate that the next chapter in people-wildlife interactions will see the expansion of wild populations, recolonization, conservation translocations and 'rewilding', side by side with human population increases. In this scenario, efforts to address potential conflicts and to promote coexistence and all its benefits become essential elements of biodiversity conservation. Large carnivores must occupy their rightful place in this picture and play a key role in biodiversity dynamics.

Fear of the unexpected and of the unknown are linked to conflict, while safe, mediated face-to-face experiences with large carnivores increase perception of control, reduce fear and may allow for a positive sense of excitement and amazement (see Johansson's research, Roskaft et al. 2007; Consorte-McCrea et al. 2017b). Most people will never have an encounter with a large carnivore in the wild, so their perceptions of risk will be based on mediated information or experiences in wildlife parks and zoos. Zoos can make a valuable contribution to coexistence by promoting opportunities for knowledge and emotional connections between people and carnivores. Individuals who become less fearful of coexistence with large carnivores are more likely to visit nature and to share these experiences with children, family and friends. This in turn would facilitate restorative experiences in nature, which are believed to be important for nurturing environmental concern.

While the need to act to reduce climate change and biodiversity loss are arguably the most pressing issues of our time, many people struggle to make connections between their actions and the often "depersonalized and distant" biodiversity crisis (Grajal et al. 2016: 323; Legagneux et al. 2018). Our contributions indicate that zoos are places where people make a connection through experience, emotion and social contact. Places where complex and shared experiences of nature can be promoted, contribute to the "construction of a social identity related to concerns for animals and the environment", and a sense of connection to the animals on site that is clearly associated with pro-environmental behaviors (Clayton et al. 2011; Grajal et al. 2016: 324).

The value of individual species or groups, such as carnivores, considering the importance of interconnectedness and the interdependence of each species within whole functional ecosystems, remains uncertain (Gascon et al. 2015). The most valuable aspect of the conservation of wild carnivores may be the potential to promote the protection of all biodiversity, as "ambassador species" (both "umbrella" and charismatic, Macdonald et al. 2017). The potential of carnivore species as surrogates for conservation marketing campaigns has not sufficiently been explored (Macdonald et al. 2017), and this suggests

an underdeveloped area where collaboration between zoos and programs for the conservation of carnivore species could be highly beneficial to biodiversity conservation.

## Finding ways to move forward

This paper is an exploratory reflection and does not intend to exhaust the subject. It rather aims to provide a catalyst for discussion that targets underexplored cooperation between large carnivore conservation programs and zoo collections, to engage the public in the urgent need to arrest biodiversity loss. Future collaborations must include both the ecological and the social-cultural dimensions of conservation. As well as investing in ways to strengthen the relationship between people and wildlife, building a relationship of trust and dialogue between conservation initiatives and distinct interest groups is paramount, and requires interdisciplinary team work (Carter and Linnell 2016; Holland et al. 2018). Ecological research alone is not enough to slow down the loss of biodiversity. Collaborations between biology professionals, social scientists and human dimensions professionals, who are better equipped to work with people, must be better funded to fill some of the gaps to address biodiversity loss.

Education, even when carried out within zoo institutions, cannot be the panacea for all conservation problems as its power is limited due to a lack of direct connection between cause and effect (Biesta 2010). Although the zoo may be a powerful facility, because of its cultural status, its impact is associated with the social context. Because of this, zoos can bring people together to talk and listen. Although the link between education with conservation and biodiversity may not be very powerful, what adults and children experience in the zoo is deep and concrete. People's accounts of their visits refer to experiences that are emotional and social, and that reflect a sense of connection with nature, in people's urbanized everyday life. Conservation initiatives should be informed by these experiences and try to build on this foundation.

Zoos also contribute to field conservation, promoting awareness and capacity building. They can help carnivore conservation programs with husbandry procedures, nutrition and veterinarian aspects, and this knowhow can help build capacity to support field conservation in different countries.

There is space for improvement. While zoos have focused visitor awareness on *ex situ* and *in-situ* conservation collaboration, messages about what visitors can do to contribute to biodiversity, including local biodiversity, through changing their behavior remain under-explored (Ojalammi and Nygren 2018). Also, as pointed by Andrew Moss, zoos must recognize the importance of social sciences collaboration in conservation: "If we don't sort out the human issues we will just be documenting the decline of biodiversity."

The focus of biodiversity conservation strategies must be to deliver long-term answers that benefit people as part of the living world (Redpath et al. 2015). By bringing people and nonhuman nature together, zoos may be well placed to convey this vision. They may provide a space where field conservation and human dimensions can combine to foster a commitment between people, from all backgrounds, and the rest of the

living world, and break down key barriers to biodiversity conservation, catalyzed by the charismatic keystone species housed within their facilities. J.V.L.B. was supported by the Ramon & Cajal program (RYC-2015- 18932) from the Ministry of Economy, Industry and Competitiveness.

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